Technological Forecasting & Social Change xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Technological Forecasting & Social Change

journal homepage: www.elsevier.com/locate/techfore

Mobile payment is not all the same: The adoption of mobile payment systems depending on the technology applied

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ARTICLE INFO

Keywords:
Mobile payments
Payments adoption
NFC
QR
SMS

ABSTRACT

This study compares the factors that determine consumer acceptance SMS (Short Message Service), NFC (Near Field Communication) and QR (Quick Response) mobile payment systems, in addition to determining the principal factors which influence the adoption of these mobile payment systems as means payment. A comprehensive review of the scientific literature has justified the development of a behavioral model that explains intention to use of mobile payments. The results and novelty of this research lies in the formulation of a different behavior according to the use given by users to each of the proposed payment tools. The conclusions and implications for management provide alternatives for companies.

1. Introduction

In recent years, payment systems have evolved from simply cash or credit card transactions to different types of mobile payment systems. This transition has taken place due to changes in the economy, technological developments on the Internet, the proliferation of social networks, and increased use of mobile devices. Since smartphones are nowadays a pervasive commodity, consumers are benefiting from the ease and convenience of paying for goods and services when approaching this new payment channel. Mobile payment systems have adapted not only to a mostly digital and mobile free reality, but also to a new business climate, facilitating business transactions anywhere, anytime and for anyone.

According Tecnocom (2015), while electronic or online payment systems have experienced significant growth, mobile payments have not met the initial expectations (Anil et al., 2003; Liang and Wei, 2004). The reasons are diverse: the strong competition between the various parties involved in the financial ecosystem (major technology companies, FinTech companies, startups, banks, etc.), the simultaneous development of FinTech industry and the challenge that implies the adoption of new FinTech systems by consumers, which is greatly impacted by the scarce knowledge regarding mobile payments (Liébana-Cabanillas et al., 2015), the user confidence doubts (Sorkin, 2001; Yu et al., 2018), the complexity of the systems, privacy concerns and a lack of security (Hwang et al., 2003; Qin et al., 2017), among other reasons.

In spite of this initial lack of success, the advances in mobile technology, the reduction of technical barriers for mobile or "m-payments", the emergence of financial-services apps and the increasing availability of mobile device lead us to believe that eventually, these means of payment will become more commonplace and simpler to use in the coming years (Liébana-Cabanillas et al., 2014; Qin et al., 2017). According to market research firm TrendForce (Hsieh, 2016), the scale of the global mobile payment market will reach US$780 billion by the end of 2017, amounting to an annual increase of 25.8%. A recent study from Accenture (2015) showed that consumers see themselves using traditional payment instruments less and digital payments more in the next years. By the end of the decade, they expect significant boosts in their use of retail apps (plus 8 percentage points), Apple Pay™/Samsung Pay™ (plus 7 percentage points) and PayPal (plus 6 percentage points).

Worldwide adoption of mobile payments is on an upward trend, but its traction depends on consumers' access to new technologies, their changing and varying lifestyle choices and also on multiple, different economic factors (Liébana-Cabanillas and Lara-Rubio, 2017). In a scenario expanding that rapidly with a growing trend as mobile payments, it is necessary to carry a further, in-depth research on the adoption process of these tools as well as to actively monitor the effects that different financial solutions have on consumers' perceptions and on their daily lives.

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https://doi.org/10.1016/j.techfore.2018.09.018
Received 18 October 2017; Received in revised form 13 August 2018; Accepted 18 September 2018

On the other hand, there is also a lack of studies comparing different technologies specifically developed to enable mobile phone payments at the point of sale while contributing relevant content to further cement the development of new financial technologies studies. By comparing different behavior patterns related to the use of a certain payment technology, it becomes possible to gather significant information on the specific strengths and weaknesses of the different mobile payment systems. This new knowledge enables and improves further development of new studies on the technologies related to these tools. In addition, the new knowledge also enhances the effectiveness of the services that the new technology provides.

In this sense, one of the purposes of this study is to contribute relevant information to the development and establishment of the mobile payments market and Fintech industry while also enhancing the development of studies related to the adoption of mobile payments and other Fintech solutions. In order to achieve this purpose, this research proposes an integrated model to compare the acceptance of mobile payments through three specific, different types of technologies (SMS, QR Code and NFC). This comparison targets the point of view of consumers, combining the evaluation attributed to four specific constructs: perceived usefulness, perceived ease of use, perceived security and subjective norms in the context of m-payments.

The contribution of this study is twofold: Firstly, this research assesses the direct and indirect effects of the determinants related to the adoption of mobile payment systems through the analysis of variables examined in traditional models (such as the Theory of Reasoned Action (TRA), or the Technology Acceptance Model, known as TAM). In addition, this research also incorporates a set of variables widely approached in the scientific literature such as perceived security in financial transactions and operations (Oliveira et al., 2016). Secondly, this research carries a comparative study from the perspective of smartphone users in order to assess three best regarded and most used mobile payment technologies. Both research purposes are critical when trying to project and predict the behavior of customers towards these payment systems already available in different markets and, on top of that, while evaluating possible future technologies related to this field of knowledge.

Based on all of the above, the proposed structure of this study is as follows: Firstly, it provides a brief explanation of each of the three technologies assessed by this research while also examining the way users employ these tools to carry out their financial activities. Secondly, the study introduces the theoretical framework of the proposed hypotheses and examines recent studies in the field of mobile payments, mobile services and their acceptance. This section also introduces the proposed model and the hypotheses that the research will be testing and supporting. Subsequently, this paper proposes an appropriate methodology for this research while also explaining the data collection process of the three different studies that it compares. After this step, this paper approaches the consequent data analysis of each of the three different studies as a whole. Finally, this research includes a section discussing the results found, the theoretical and practical implications and also the limitations and suggestions for future research opportunities.

2. Mobile payment systems: SMS, NFC and QR

Dewan and Chen (2005) defined m-payment as the act of “make payments using mobile devices including wireless handsets, personal digital assistants (PDA), radio frequency (RF) devices, and NFC based devices”. According to Luna (2017), “It is a type of financial process of a private or business nature, in which an electronic mobile communication device is used to initiate, authorize and carry out a financial transaction”. For the purpose of this study, we have adopted the definition by Liébana-Cabanillas (2012) who summarized the previous authors' view as follows: “business activity involving an electronic device connected to a mobile network enabling the successful completion of an economic transaction”.

Innopay (2013) classifies mobile payment systems according to two criteria: proximity and business model. Proximity payments are classified based on the physical location of a consumer; for example, close proximity at the counter of a store, or remote payments, such as online payment through a mobile phone. Secondly, the business model is characterized based different consumer relationships (Peer to Peer or Consumer to Consumer, C2C or P2P, respectively) or relationships between companies and customers (Business to Consumer, B2C). In our research we analyze mobile payment systems from the perspective of B2C discussing the three main technologies that are currently developed, SMS, NFC and QR.

The first (SMS) is remote and the second and third (NFC and QR) are proximity systems. The use of SMS for mobile payment requires a communication protocol enabling the exchange of short text messages between two mobile devices (Valcourt et al., 2005). SMS employs the following technologies: GSM (Global System for Mobile Communications), GPRS (General Packet Radio Services) and UMTS (Universal Mobile Telecommunications System) (Sebola and Penzhorn, 2003). This type of payment is particularly popular in several countries in Africa where there are large unbanked populations, where the use of cash may be common but risky, and where smartphone penetration is low and internet access scarce (Fernández, 2015; Lowry, 2016). However, certain problems regarding consumer protection have arisen in SMS payments that are billed directly to mobile phone invoices (Luna, 2017). In fact, due to cases of unauthorized third party charges on phone bills, the major mobile operators in the US have halted the offer of this service (Lowry, 2016).

Due to the rapid growth of smart phones and their many applications, the use of NFC is on the rise. In contrast to SMS payment systems, both NFC and QR payments are made in person in a store or at a compatible terminal by simply approaching the terminal with a mobile device. This technology attracted a lot of attention, especially since it is an easy-to-use method for data exchange that requires simply to approximate the devices and the functions of NFC technology are unlimited as it can be integrated in many features (Luna, 2017).

Among its advantages are (Grassie, 2007): The first is its scope and availability; it can be implemented in all existing mobile terminals with the incorporation of a dedicated chip, thereby generating a wide range of new services for users and the terminal itself. Furthermore, NFC technology has a wide range of applications, including paying bills, car payments or for leisure activities. Third, it is easy to use because NFC only requires that the parties involved be within a specific proximity. Additionally, NFC payment is secure as it requires the user to manually activate or approach the receiver for payment, demanding proactive behavior from the user. This payment system also generates added value services, it can be used on devices equipped with contactless features, as a platform to receive cash, make payments and pay for transport worldwide. Finally, NFC is economically attractive because it is based on open standards and users are not obliged to pay for licensing fees.

Another form of contactless communication comes in the form of QR codes. QR codes are storage systems which use a dot matrix or two-dimensional bar code developed by Denso Wave that can be printed or shown on a screen and are interpreted by a special reader (Denso Wave, 2000) to provide more extensive information than that found in a traditional bar code. The information that is normally linked to a QR code includes (Fonseca et al., 2012) web addresses (pages, locations Google Maps, iTunes or YouTube links, etc.), basic texts (alerts, SMS, e-mail, messages, etc.) or numeric information (phone numbers, coordinates, etc.).

In the scientific literature there are many studies on the implementation of these codes and their uses in different ways, including passengers' mobile ticketing (Cheng and Huang, 2013) and mobile learning (Lai et al., 2013) among others. However, although currently the QR system is technically being employed, there is no study directly

analyzing the use of the system (as employed in the manners mentioned above, nor in m-payments). This makes the current study more significant.

According to the recent study by ScanLife Mobile Barcode Trend Report of ScanBuy (2013) the appearance of QR codes grew > 1300% over the previous year, used mainly in packaging, mail, magazines and newspapers. The primary users of QR codes are Android OS users (60%), followed by iPhone OS users (37%), though their use in other operating systems is currently trivial. Although there have been many attempts in the last decade to use mobile devices for business-to-consumer payments (B2C), none have been particularly successful (Pousttchi et al., 2009) due to various deterrents: (1) the high costs derived from the implementation of the new technology and the ensuing financial fees (Islam et al., 2010), (2) the complexity of the systems (Balan et al., 2009), (3) the diversity of the types of services and the lack of unified payment systems (Liébana-Cabanillas, 2012), (4) the diverse range of terminal types that hinders the implementation of uniform security, control and monitoring measures (Islam et al., 2010), (5) the distrust of these types of transactions (Wu et al., 2010), (6) the immaturity of some markets, especially emerging economies, that reject the new technology (Wu et al., 2010), and finally, (7) the limited rate of penetration in Third World countries and emerging economies (Saidi, 2010).

Given the potential of this new market, and the limited amount of relevant published scientific research, our study aims to analyze the determining factors associated with the adoption of new mobile payment technology by focusing on the three previously cited payment systems (SMS, NFC and QR).

To achieve this, we have applied a revised model of theoretical behavior deriving from classic theory. First, we review the different variables that have been analyzed in recent years in the study of mobile commerce and mobile payment models by means of the Technology Acceptance Model (TAM) to compare and justify the suitability of the proposed model. From the results obtained after evaluating the process of acceptance of mobile payment technologies, this research suggests a variety of recommendations from a business standpoint to improve the intention to use of potential consumers by means of specific strategies.

3. Theoretical framework: consumer mobile behaviour

Among the classic theories that explain human behavior related to adopting new technologies are the Theory of Reasoned Action (TRA), developed by Ajzen and Fishbein (1980), and the Theory of Planned Behavior (TPB) by Ajzen (1991). Both have been widely applied as the principal theoretical framework for understanding and explaining the adoption and usage behavior of various information systems. According to Yang et al. (2012), the TRA and the TPB state, “an individual's intention to adopt an innovation is determined by attitude and subjective norms, which are formed by behavioral and normative beliefs of an individual.”

Davis (1989) developed the Technology Acceptance Model (TAM) on the basis of these theories. TAM suggests that the perceived usefulness and ease of use by an individual are the factors that determine the attitude towards the adoption of a specific technology, and consequently determine intention to use resulting in the adoption of the technology (Davis et al., 1989). This model has been applied in many fields such as usability test (Lin, 2013), mobile services (Wang and Li, 2012), mobile wireless (Kim and Garrison, 2009), mobile ticketing (Suki and Suki, 2017), mobile banking (Mehrad and Mohammadi, 2017), e-government (Rana et al., 2014) and mobile payments (Leong et al., 2013; Liébana-Cabanillas et al., 2017; Ramos-de-Luna et al., 2016), among others.

Although the TAM has undergone several revisions (Lee et al., 2003), it is still considered the most solid, rigorous and influential model related to the behavior of technology acceptance (Davis, 1989; Davis et al., 1989; Wu et al., 2011). Precisely for this reason it has been adopted in many studies related to mobile payment (Di Pietro et al., 2015; Liébana-Cabanillas et al., 2015; Lu et al., 2011; Ramos-de-Luna et al., 2016; Tan et al., 2014; Yang et al., 2012), but in no case has previous research comparatively evaluated mobile payment systems together, reinforcing the importance of our research.

3.1. Literature review of research on the adoption of mobile services and mobile payments

There are multiple studies in the literature examining the different factors involved in the adoption of mobile services and mobile payments (M-payment). In this regard, Keramati et al. (2012) assessed the adoption of the services related to mobile payment through a conceptual model combining technological factors and behavioral factors of M-payment services adoption. Their research reported that variables such as perceived ease of use (PEOU), perceived usefulness (PU), trust, compatibility, cost, norm, payment habit, availability of mobile phone skills, and convenience are fit for this type of research and that these factors can influence adoption largely.

Along these lines, Tossy et al. (2012) evaluated the factors influencing the use of mobile phones while approaching the payment of examination fees among primary and secondary school students. The rationale of this study is based on the fact that most scholars claim that while number of mobile phones ownership, access and usage in primary and secondary school students increases, there is a decrease in the number of actual students opting for mobile examination fee payment methods. This study identified three significant factors: performance expectancy, social influences and trust.

In a similar vein, Yang et al. (2012) identify the determinants of pre-adoption of mobile payment services and explore the temporal evolution of these determinants across the pre-adoption and post-adoption stages from a holistic perspective including behavioral beliefs, social influences, and personal traits. Their most significant findings show that behavioral beliefs in combination with social influences and personal traits are all important determinants for mobile payment services adoption and use, but their impacts on behavioral intention do vary across in different stages.

Respecting the most recent Near Field Communication (NFC) technology, Leong et al. (2013) studied the determinants factors influencing the adoption of NFC-enabled mobile credit cards through the analysis of constructs from psychological science and trust-based, behavioral control theories incorporated into the TAM. Their findings revealed that there is a significant and direct relationship between both the perceived ease of use and the perceived usefulness on the intention to use (IU) while other variables such as trust and personal innovativeness in information technology (PIIT) have significant indirect effects on the intention to use. Similarly, they also reported that variables such as trust and PIIT have a significant, direct effect on the perceived ease of use and the perceived usefulness whereas the perceived usefulness has a mediating effect between the perceived ease of use and the actual intention to use.

In this sense, research by Hamza and Shah (2014) examines the relationship between gender and the factors that determine the adoption of mobile payment system among the students of tertiary institutions in Nigeria. By using the Technology Acceptance Model (TAM) with two additional variables to form the conceptual model which comprises of perceived usefulness, perceived ease of use, perceived compatibility (PC) and social norm. Their findings revealed that perceived ease of use, perceived usefulness and social norm influence the behavioral intention to adopt mobile payment system among the students and that the influence of the perceived ease of usage and social norm differs among the gender of the students, with male students having a higher perceived ease of use over their female counterpart. On the other hand, social norm influences female students more than their male counterpart when adopting mobile payment. However, no significant difference was found in the general adoption of the mobile

payment system among gender.

In a similar research, Jaradat and Al-Mashaqba (2014) investigated the key factors that affect individuals' intention to adopt and the use of mobile payment in Jordan, based on the Technology Acceptance Model 3 (TAM3). Their results show that both user's adoption and the use of M-payment services can be anticipated from users' behavioral intentions, which are significantly affected by the following variables: Perceived usefulness, perceived ease of use, subjective norms (SN), image, output quality, self-efficacy, perceptions of external control and, lastly, playfulness.

Also worth examining for our research was the work of Jaradat and Faqih (2014), which developed a theoretical research model as a framework based on a modified Technology Acceptance Model 2 (TAM2), integrating the moderating influence of gender and self-efficacy on the adoption process of mobile payment in the current model. This particular research concluded that the perceived usefulness and perceived ease of use along with the subjective norms, output quality, and result demonstrability variables are all important determining factors of behavioral intention towards mobile payment adoption. Also, image and output quality were empirically reported as significant determinants influencing the construct of perceived usefulness and also indirectly influencing the intention to use.

Also relevant for our research, the work of Thakur and Srivastava (2014) recently analyzed the adoption readiness, perceived risk and the intention to use regarding mobile payments in India while investigating the stability of different proposed structural relationships of the aforementioned variables across different customer groups. It is also worth mentioning a later work by Koenig-Lewis et al. (2015) that, using the TAM and the unified theory of acceptance and use of technology (UTAUT) as a base, extended these frameworks by incorporating variables such as perceived enjoyment, social influence, knowledge and perceived risk. Against expectations, their results showed that perceived ease of use had no significant effect on the perceived usefulness and the intention to use (IU).

Since our research addresses the NFC technology, we also approached Ramos-de-Luna et al. (2016) who examined the factors of consumer acceptance of mobile payment systems using NFC technology through a conceptual model which was based on the TAM and included the perceived compatibility, perceived security, personal innovativeness and individual mobility in the research model. Their results indicated that variables such as attitude, subjective norms and personal innovativeness are determinants of the future intention to make payments via the NFC technology.

Also relevant for our research is the results that Oliveira et al. (2016) reported after evaluating a sample of users from Portugal. Their innovative analysis based on the extended unified theory of acceptance and use of technology (UTAUT2) model, incorporating variables relying on the diffusion of innovations (DOI) theory such as the perceived security (PS) and the intention to recommend the technology as the main constructs. This research found compatibility, perceived technology security, performance expectations, innovativeness, and social influence to have significant direct and indirect effects over the adoption of mobile payment and the intention to recommend the different mobile payment systems. As far as our research is concerned, authors consider this work as a pioneering comparative study on the different, most accepted mobile payment systems. There is no other current study in the existing scientific literature comparing these different, innovative payment tools.

3.2. Conceptual model and research hypothesis

Most research on the adoption of mobile payment technologies and mobile services is based on existing technologies and their use. The objective of this study is to comparatively analyze the adoption of three innovative mobile payment systems and create a model of behavior towards mobile payment systems based on extensions of the TAM. The present study specifically proposes the following ideas: (1) that subjective norms may have a direct or indirect impact on the intention to use, ease of use and perceived usefulness, (2) that the ease of use determines the usefulness of the payment devices and the consumer's attitude, (3) that the potential consumers' perceived usefulness of the service is related to their attitude and to the intention to use mobile payment methods, (4) that the attitude determines directly the intent, and (5) that the perception of security positively affects the behavior of the consumer. We have selected this last security variable since, along with the question of risk, it is the most common variable cited in the existing research.

3.3. Subjective norms

Social influences in the form of subjective norms are used as factors both in models of technology acceptance and in their subsequent adaptations (Venkatesh and Bala, 2008). This factor is defined as the degree that individuals' perception of what people important to them consider on whether they should adopt a system or perform a certain action (Venkatesh and Bala, 2008).

The subjective norm, in the context of mobile payment, is the degree to which a social environment perceives mobile payment as desirable (Schierz et al., 2010). This social construct is composed of two basic underlying sets of factors. First are the beliefs that consumers have about the people they regard as a reference, and second is the motivation of individuals to behave according to the desires of the people of reference (Herrero et al., 2005).

From this point of view, many authors have identified a direct and positive link between subjective norms and ease of use (Svendsen et al., 2013), usefulness (Schepers and Wetzels, 2007) and, of course, the intention to use (Jin et al., 2012; Martins et al., 2014). Therefore, we propose the following hypotheses:

Hypothesis 1. Social influences in the form of subjective norms positively affect the perceived ease of use of adopting mobile payment services.

Hypothesis 2. Social influences in the form of subjective norms positively affect the perceived usefulness of adopting mobile payment services.

Hypothesis 3. Social influences in the form of subjective norms positively affect the intention to adopt mobile payment services.

3.4. Perceived usefulness

Perceived usefulness is the subjective probability that technology can improve the way a consumer completes his goal. In online environments, usefulness is perceived as the degree to which a consumer believes an online purchase will provide access to useful information, and allow a faster purchase (Vijayasarathy, 2004. In the context of our study, perceived usefulness will improve the consumer's attitude and intention to use mobile payment systems.

According to TAM, the perceived usefulness is the degree to which a person believes that adopting a particular system will increase his effectiveness and job performance (Davis, 1993). Different studies have demonstrated that perceived usefulness has a direct relationship with attitude (Hsu and Chiu, 2004; Kim and Shin, 2015), as well as the intention to use (Huang et al., 2013).

In the context of our research, we consider that perceived usefulness of the payment system will influence the intention to use through a user's attitude towards the payment system. Based on the preceding thoughts, we propose the following hypotheses:

Hypothesis 4. Perceived usefulness has a significant positive effect on the attitude towards the intention to use mobile payment systems.

Hypothesis 5. Perceived usefulness has a significant positive effect on

the intention to use mobile payment systems.

3.5. Ease of use

Ease of use refers to an individual's perception that using a particular system will be effortless or, simply, easy to handle (Taylor and Todd, 1995). Therefore, this is considered one of the most influential aspects regarding the decision to adopt new technology. For Davis et al. (1989) the question of ease of use has a double impact. It has, on the one hand, an impact on attitude, because of self-efficacy and instrumentality, and secondly by its utility as shown by the TAM (Muñoz, 2008).

The effect of the perceived ease of use of a product on the perceived usefulness has been demonstrated in numerous studies in different contexts (e.g. Liébana-Cabanillas et al., 2012; Muñoz et al., 2012). The relationship between the ease of use, attitude and intention to use has also often been examined (Schepers and Wetzels, 2007). Under such circumstances, we proffer the following hypotheses:

Hypothesis 6. The perceived ease of use positively influences the usefulness in the adoption of mobile payment systems.

Hypothesis 7. The perceived ease of use positively influences the attitude towards the intention of mobile payment systems.

3.6. Attitude

Fishbein and Ajzen (1975) consider attitude to be a multidimensional construct, consisting of cognitive, affective and conative or behavioral factors. The cognitive component refers to what a person knows about a product or service (experiences, beliefs and opinions), the affective component refers to the individual's own tastes about that object (feelings, emotions and values) and, finally, the behavioral component refers to behavioral intention (purchase intent, purchase response and rejection response) (Alonso and Grande, 2004). The main criticism of this conception of attitudes is a lack of independent measures, as most factors relate to the affective component, which greatly hinders accurate measurement of the attitudes of users.

Consequently, in the online environment, it is expected that attitude facilitate transactions and reduce the barriers to the adoption of the terms of trade (Pavlou, 2002a; Pavlou, 2002b), and more specifically, in our case, favor the intention to use mobile payment systems (Schierz et al., 2010). In line with previous research (Tsai et al., 2010), we propose a similar relationship in the case of the new systems of payment. This results in the following hypothesis:

Hypothesis 8. The attitude towards the intention to use is an antecedent of intention to use mobile payment systems.

3.7. Perceived security

In addition to the perceived benefits (perceived ease of use and usefulness), new technologies also pose some associated risks associated, in our case, concerning privacy, personnel data, and the transaction itself further increasing the perceived risk of mobile payment services (Shah et al., 2014). For this reason, security and risk perception are major concerns in the field of electronic payment systems (Ashrafi and Ng, 2008) and act as inhibitors of intended use of new mobile payment tools (Lee, 2009). Thus, the perception of security of the mobile payment system must be controlled (Meharia, 2012) in order for this type of technology to be successfully used (Grassie, 2007).

As such, we feel that the perception of security in accepting new payment systems must be controlled (Schierz et al., 2010) if this type of technology to be successful (Grassie, 2007). Consequently, we propose the following research hypothesis:

Hypothesis 9. Perceived security positively influences the intention to use mobile payment systems.

3.8. Comparative analysis of SMS, NFC and QR payment systems

Besides the classical approaches on the previous variables, the novelty of our research lies in the formulation of a different behavior according to the use given by users to each of the proposed payment tools. We therefore put forward the following research hypothesis:

Hypothesis 10. Users' behavior towards the proposed payment systems will differ from one system to another.

4. Methodology: scope of study, measurement scales and data collection

To evaluate the proposed behavioral model, three self-administered questionnaires were created to be filled out by the consumer after watching an explanatory video of the mobile payment procedure with one of the technology object of the study (SMS, NFC or QR code). We developed three different explanatory videos to measure separately the consumer perceptions about each technology payment systems. Each survey contains the same questions and only differs as to the proposed payment system (SMS, NFC or QR code), in the questions terms (see Appendix A) and in the video displayed.

Prior to distribution, each of the three questionnaires was subjected to several preliminary tests to ensure its reliability, and to verify the suitability of the measurement scales, their reliability and validity were analyzed by both exploratory (SPSS 18.0) and confirmatory (AMOS 18) methods (see Data analysis section).

In order to achieve the goals of this study, our research was developed sequentially over these past years with the purpose to assess and evaluate the different mobile payment tools developed and introduced in recent years. During the first stage of our research, the SMS technology is assessed in the first place, as it was the pioneering tool in 2012 for mobile payments. After this initial step, we immediately turn the focus to other technologies such as NFC (2012) and QR codes (2013) since these technologies have currently increased their presence in the technology market to make payments in the last 5 years (Luna, 2017) and are nowadays considered as the most widely extended and approached by smartphone users as previously forecasted. For the SMS and QR payment system survey, we employed a quota sampling method based on the characteristics of consumers reflected in the Survey on Equipment and Use of Information Technologies and Communication in Homes reported by the Spanish Statistical Office (INE[1]). On the other hand, for the NFC payment technology we applied a convenience sampling method making use of the Facebook social network. In this research, we approached two different criteria in order to find potential different results that in the end the different analysis tools were not able to identify, therefore validating both of the assessed criteria for this research.

The SMS payment system survey was conducted between January and February 2012 and the sample was composed of 287 valid surveys. The NFC payment system survey was conducted between July and August 2012 and attained a valid sample size of 287. Lastly, the QR code payment system survey was conducted between February and March 2013 and the sample was composed of 168 valid responses. The demographic profiling data of the respondents is available on Appendix B.

[1] Instituto Nacional de Estadística (2012), Encuesta sobre Equipamiento y Uso de Tecnologías de la Información y Comunicación en los hogares, available www.ine.es.

5. Data analysis

5.1. Reliability and validity

Cronbach's α indicator was first used to measure the reliability of the scales, with 0.7 as the reference value (Hair et al., 1995; Nunnally, 1978). All the variables obtained very good values in the three groups or subsamples (α > 0.8). To test the convergent and divergent validity of the scales, a confirmatory factor analysis was performed. In this analysis the different items that contributed least to the explanatory power of the model were eliminated ($R^2 > 0.5$). Convergent validity was evaluated by means of the factor loadings of the indicators. The coefficients were significantly different from zero, and the loadings between latent and observed variables were high in all cases (β > 0.7). Consequently, we can deduce that the latent variables adequately explain the observed variables (Bollen, 1989; Hair et al., 1995).

With regard to discriminant validity, the variances were found to be significantly different from zero. Moreover, the correlation between each pair of scales did not exceed 0.8. Given the weak relationship among the constructs, we can therefore confirm that there are five constructs in each of the three models proposed.

The reliability of the scales can again be evaluated from a series of indicators drawn from the confirmatory analysis. The composite reliability and the average variance explained exceed the threshold used as a reference at 0.7 and 0.5, respectively, as well as other indicators of overall fit for the measurement model (Bollen, 1987; Hair et al., 1995) (Table 1).

5.2. Structural equation model

After evaluating the reliability and validity of the measurement scales, the research hypotheses based on the review of the literature were tested. For this, a structural equation model was developed for each group. Considering the absence of normality of the variables, we opted for the maximum likelihood estimation method and bootstrapping technique (or bootstrap learning samples) for 500 consecutive steps or samples, and a significance level of 95%. The maximum likelihood is preferable in the case of small samples, as opposed to generalized or weighted least squares (West et al., 1995). In the bootstrapping technique we used the Bollen-Stine's corrected *p*-value, testing the null hypothesis that the model is correct. Through re-sampling, this technique permits the standard error of the constructs to be corrected.

Before evaluating each of the three models in further depth and examining the differences among them, the overall goodness of fit was verified to be satisfactory as the values of the goodness of fit indicators were within the levels recommended in the literature (Bollen, 1987; Bollen, 1989; Lai and Li, 2005). In our case, RMSEA < 0, 08 GFI and AGFI > 0, 80, CFI and NFI > 0, 90 (see Table 2).

5.3. Hypothesis testing

To assess the structural model for statistical significance, the model structural loads were analyzed. Both the SEM analysis results and the results of the hypotheses are shown in Fig. 1 and Table 3.

In the first place, hypotheses 1, 2 and 3, deriving from the effect of subjective norms over the ease of use, perceived usefulness and intention to use, cannot be rejected ($p < 0.001$). In this case the subjective norms have a direct and positive relation over the ease of use (βsms = 0.34 $p < 0.001$; βnfc = 0.41 $p < 0.001$; βqr = 0.24 $p < 0.001$), over the usefulness (βsms = 0.47 $p < 0.001$; βnfc = 0.39 $p < 0.001$; βqr = 0.28 $p < 0.001$) and over the intention to use (βsms = 0.12 $p < 0.10$; βnfc = 0.35 $p < 0.001$; βqr = 0.17 $p < 0.001$). These results reinforce the conclusions of previous research (Bhattacherjee, 2001).

Secondly, the relationship between the usefulness and the attitude

Table 1
Convergent validity and internal composite reliability.

Relationships between constructs		SMS				NFC				QR			
		Standard coefficient	Cronbach's α	Composite reliability	Variance explained	Standard coefficient	Cronbach's α	Composite reliability	Variance explained	Standard coefficient	Cronbach's α	Composite reliability	Variance explained
Subjective norms	→ SN1	0.879	0.92	0.92	0.79	0.887	0.93	0.93	0.82	0.869	0.91	0.92	0.80
	→ SN2	0.874				0.951				0.978			
	→ SN3	0.908				0.879				0.824			
Perceived ease of use	→ PEOU1	0.782	0.80	0.83	0.81	0.741	0.91	0.92	0.74	0.757	0.92	0.92	0.75
	→ PEOU2	0.942				0.810				0.815			
	→ PEOU3	0.899				0.938				0.925			
	→ PEOU4	0.789				0.936				0.942			
Perceived Usefulness	→ PU1	0.816	0.92	0.93	0.76	0.769	0.87	0.88	0.65	0.752	0.88	0.88	0.65
	→ PU2	0.957				0.819				0.749			
	→ PU3	0.827				0.858				0.872			
	→ PU4	0.880				0.859				0.835			
Attitude	→ AT1	0.761	0.93	0.93	0.78	0.855	0.92	0.92	0.74	0.836	0.89	0.89	0.67
	→ AT2	0.935				0.866				0.785			
	→ AT3	0.918				0.894				0.853			
	→ AT4	0.911				0.832				0.803			
Perceived Security	→ PS1	0.730	0.88	0.88	0.71	0.911	0.92	0.93	0.81	0.850	0.91	0.94	0.83
	→ PS2	0.855				0.940				0.995			
	→ PS3	0.934				0.847				0.883			
Intention to use	→ IU1	0.892	0.94	0.94	0.83	0.880	0.93	0.93	0.82	0.825	0.94	0.91	0.78
	→ IU2	0.904				0.893				0.897			
	→ IU3	0.944				0.948				0.925			

Table 2
Goodness-of-fit indicators in the structural model.

Coefficients[a]	RMSEA	$\times^2$	Df	Bollen-Stine's p	NCP	RFI	GFI	AGFI	NFI	CFI	IFI
SMS	0.060	364.820	179	0.002	185.820	0.918	0.892	0.860	0.930	0.963	0.963
NFC	0.062	378.041	179	0.001	199.041	0.922	0.886	0.853	0.933	0.964	0.964
QR	0.065	303.897	179	0.040	124.890	0.886	0.857	0.815	0.903	0.957	0.958

[a] Notes: RMSEA, root mean square error of approximation; NCP, noncentrality parameter; RFI, relative fix index; GFI, goodness-of-fit index; AGFI, adjusted goodness-of-fit index; NFI, normed fit index; CFI, comparative goodness of fit; IFI, incremental fit index.

and intention in hypotheses 4 and 5 also cannot be dismissed. In this situation, the usefulness that the consumer displays towards the payment device will have a direct effect both on his attitude towards it (βsms = 0.48 $p < 0.001$; βnfc = 0.96 $p < 0.001$; βqr = 0.62 $p < 0.001$) and on his intention to use it in the future (βsms = 0.16 $p < 0.10$; βnfc = 0.34 $p < 0.001$; βqr = 0.39 $p < 0.001$). These relationships involve a direct and positive relationship between the value of the means of payment and the user's attitude and intention towards it (Liébana-Cabanillas et al., 2015; Lorenzo et al., 2011).

Furthermore, the hypothesis derived from the effect of ease of use (hypotheses 6 and 7) could not be categorically rejected. The relation between perceived ease of use and perceived usefulness were observed in all three cases (βsms = 0.27 $p < 0.001$; βnfc = 0.5 $p < 0.001$; βqr = 0.64 $p < 0.001$), whereas the relationship between perceived ease of use and attitude was only corroborated in the SMS model (βsms = 0.21 $p < 0.001$; βnfc = −0.08 $p > 0.10$; βqr = −0.0005 $p > 0.10$) while being rejected in other cases. These results demonstrate that users place less importance on the relationship between perceived ease of use and attitude than the literature suggests (Lorenzo et al., 2011) and lends greater importance to the perceived usefulness as a factor of intended use.

Moreover, hypothesis 8, which relates a favorable attitude towards the payment system and its intended use, cannot be completely rejected (βsms = 0.27, $p < 0.001$; βnfc = 0.37, $p < 0.001$; βqr = 0.43 $p < 0.10$). Following the research of Ajzen and Fishbein (1980) and other later studies, the favorable attitude of a consumer towards a mobile payment tool proposal will improve intention to adopt it. Even though it is difficult to define the attitude of a potential user due to the multidimensionality of the construct, this relationship has been proven in research related to purchasing via mobiles (Aldás-Manzano et al., 2008) or mobile payment systems (Schierz et al., 2010), among others.

Finally, hypothesis 9, regarding the positive relationship between perceived security and the intention to use, cannot be either rejected in the SMS and NFC models, nor corroborated in the QR model (βsms = 0.07 $p < 0.10$, βnfc = 0.07 $p < 0.10$; βqr = 0.062 $p > 0.10$).

5.4. Comparison of models

To demonstrate the existence of a common model for the three payment systems (SMS, NFC and QR) after they were evaluated, we compared the regression coefficients or weights in pairs between the structural models using a modified version of Student's *t*-test for independent samples (Chin, 2000; Goodman and Blum, 1996). Chin's (2000) suggested statistical comparison procedure was used to develop a multi-group analysis, based on implementations in previous past research (Lu et al., 2010; Lu and Hsiao, 2010; Yeh et al., 2012). The evaluation was performed using the procedure suggested by Chin (2000) to develop a multi-group analysis based on Student's *t*-test (using a parametric analysis through a t-test of m + n + 2° of freedom) according to the following formulation:

Ho: B1 = B2 $$t = \frac{B_1 - B_2}{\sqrt{SE_1^2 + SE_2^2}}$$

where Bi denotes path weights and SEi is the standard error of the path in the structural model.

The results reveal significant differences (significance < 0.05 and < 0.10) in the relationships between certain variables of the three structural models (see Table 4), which is the reason why hypothesis 10 could not be rejected. With respect to the comparison between the SMS and NFC models, differences are especially pronounced in the relationships between subjective norms and intention to use

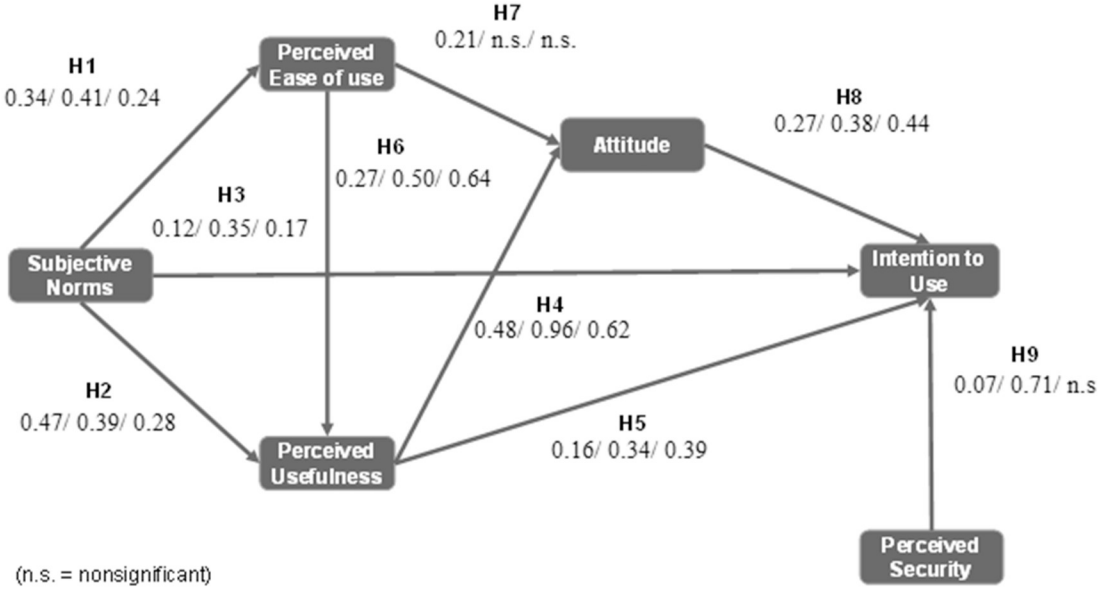

Fig. 1. Behavioral models (standardized beta): SMS payment/NFC payment/QR payment.

Table 3
Non- standardized coefficients (β) of the models.

Hypothesis	SMS			NFC			QR		
	β_{sms}	S.E.	Sig.	β_{nfc}	S.E.	Sig.	β_{qr}	S.E.	Sig.
H1. SN → PEOU	0.34	0.07	[b]	0.407	0.05	[b]	0.242	0.06	[b]
H2. SN → PU	0.47	0.06	[b]	0.390	0.05	[b]	0.284	0.07	[b]
H3. SN → IU	0.12	0.06	[a]	0.353	0.07	[b]	0.172	0.07	[b]
H4. PU → ATT	0.48	0.05	[b]	0.955	0.11	[b]	0.615	0.08	[b]
H5. PU → IU	0.16	0.07	[a]	0.336	0.11	[b]	0.390	0.15	[b]
H6. PEOU → PU	0.27	0.05	[b]	0.500	0.07	[b]	0.644	0.11	[b]
H7. PEOU → ATT	0.21	0.05	[b]	−0.080	0.09	n.s.	−0.0005	0.07	n.s.
H8. ATT → IU	0.27	0.07	[b]	0.375	0.08	[b]	0.437	0.20	[a]
H9. PS → IU	0.07	0.04	[a]	0.078	0.05	[a]	0.062	0.06	n.s.

[a] 0.1 of significance.
[b] 0.001 of significance.

(dif. = −2.58; $p = 0.01$), perceived usefulness and attitude (dif. = −3.92; $p = 0.00$), perceived ease of use and perceived usefulness (dif. = −2.69; $p = 0.00$), and finally, perceived ease of use and attitude (dif. = 2.87; $p = 0.00$). The largest differences are between perceived usefulness and attitude and perceived ease of use and attitude. Ease of use is more important in the SMS payment system due to its relationship with attitude, while subjective norms and perceived usefulness show greater relevance with the NFC payment system due to their impact on attitude and intention.

In the shaded cells of Table 4 it is possible to observe the relations between variables that presented significant difference between models. In the comparison between the SMS and QR models, there were also significant differences, this time between subjective norms and perceived usefulness (dif. = −2.08, $p = 0.04$), subjective norms and intention to use (dif. = −1.68, $p = 0.09$), perceived ease of use and perceived usefulness (dif. = −3.13, $p = 0.00$) and perceived ease of use and attitude (dif. = 2.59, $p = 0.01$). Here, the main differences are between perceived ease of use and perceived usefulness and between ease of use and attitude.

Finally, in the comparison between the NFC and QR models, significant differences were observed in the relation between subjective norms and perceived ease of use (dif. = 1.99; $p = 0.05$) and perceived usefulness and attitude (dif. = 2.52; $p = 0.01$).

The results indicate that the model of mobile payment behavior cannot be applied in a global manner and the relationships proposed in the model are expressed with different intensity depending on the system of payment that is under study.

6. Discussion and conclusions

6.1. Summary of findings and theoretical implications

While there are numerous studies analyzing the acceptance of new technologies, our research is novel from a dual perspective. First, it provides a comparative analysis of the three main mobile payment systems commonly used today by companies and, secondly, this research was carried out in Spain where all three technologies have incipient penetration level so the results have practical applications.

The principal aim of this research is to analyze consumer acceptance of SMS, NFC and QR code mobile payment systems from a behavioral model standpoint and determine its constitutive factors. In this sense, the models presented an explained variance of the intention to use of 0.317, 0.654 and 0.574 respectively. With this objective, we reviewed related variables to the Technology Acceptance Model in different contexts associated with payment systems such as online banking, mobile banking and mobile payments (Chandio et al., 2013; Kirlidog and Kaynak, 2011; Tan et al., 2014), defining an extended model of TAM from risk analysis of perceived security which users manifested in the process of adopting a new payment system through mobile technology.

The results of the study are consistent with those in the literature, namely that the original TAM is a robust and parsimonious underlying model for the study of mobile payment systems (Fig. 1).

In our case, all TAM model relations are verified in the three systems except the relationship between ease of use and attitude in NFC and QR

Table 4
Differences in the non-standardized coefficients (β) of the models.

	SMS-NFC	T (SMS-NFC)	SIG.	SMS-QR	T (SMS-QR)	SIG.	NFC-QR	T (NFC-QR)	SIG.
H1. SN → PEOU	−0.07	−0.83	0.41	0.09	1.01	0.31	0.17	**1.99**	**0.05**[a]
H2. SN → PU	0.08	1.08	0.28	0.19	**2.08**	**0.04**[a]	0.11	1.18	0.24
H3. SN → IU	−0.23	**−2.58**	**0.01**[a]	−0.27	**−1.68**	**0.09**[b]	−0.04	−0.22	0.83
H4. PU → ATT	−0.48	**−3.92**	**0.00**[a]	−0.14	−1.48	0.14	0.34	**2.52**	**0.01**[a]
H5. PU → IU	−0.17	−1.37	0.17	−0.23	−1.38	0.17	−0.05	−0.29	0.77
H6. PEOU → PU	−0.23	**−2.69**	**0.01**[a]	−0.37	**−3.13**	**0.00**[a]	−0.14	−1.14	0.25
H7. PEOU → ATT	0.28	**2.87**	**0.00**[a]	0.22	**2.59**	**0.01**[a]	−0.07	−0.58	0.56
H8. ATT → IU	−0.10	−0.94	0.35	−0.16	−0.79	0.43	−0.06	−0.29	0.77
H9. PS → IU	−0.01	−0.22	0.82	0.00	0.04	0.97	0.02	0.21	0.84

Note: SIG.: Significance.
[a]Significant difference for a significance level of 5%.
[b]Significant difference for a significance level of 10%.

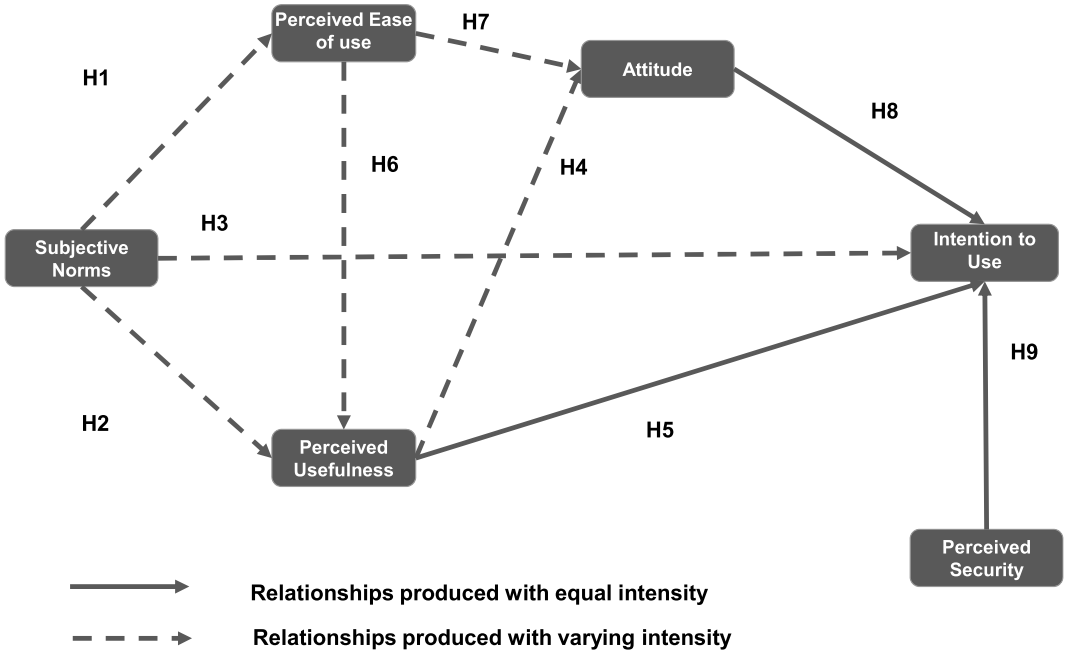

Fig. 2. Extended model underlying all mobile payment systems model.

mobile payment systems. This may be due to the high adoption by users of mobile terminals whenever there is very high penetration of such terminals in the population, showing users there is no difficulty in handling the tool itself and consequently, eliminating a drawback to its adoption. However, there are differences in the three models in the final definition of the intention to use of the potential user (Fig. 2).

In the SMS mobile payment system, the most important variables affecting intention to use were subjective norms, and social influence, followed by perceived usefulness, attitude, perceived ease of use and perceived security. In the NFC mobile payment system, the total effect on intention comes from subjective norms, perceived usefulness, attitude, perceived ease of use and perceived security. Finally, in the QR mobile payment system, the biggest effect on intention to use comes from perceived usefulness, followed by subjective norms, perceived ease of use, attitude and perceived security.

As noted, one of the most important variables in the three payment systems are subjective norms. We attribute this importance to the current high level of interconnection between individuals on account of the rise of mobile communication technologies. This implies that some consumers hold the opinions of those that they consider really important to them in high regard. In the case of QR mobile payment systems, the variable with the greatest effect on intention is perceived usefulness, unlike SMS and NFC systems where this variable is in second place. In any case, in all three models, subjective norms and perceived usefulness have great influence on intention.

Attitude is also an essential determinant factor related to the question of intention to use a new payment system. It expresses, in fact, a significant, positive and direct effect on the intention to use. Specifically, to some extent, the feelings or attitudes of a consumer also determine his/her predisposition to use a new technology. The strength of the effect on the attitude towards use is lower, probably because the consumer, due to the novelty of the service, does not possess enough arguments or information to make a real judgment on future use. In spite of the lack of information, the consumer's attitude also has a decisive influence on the intention to use new mobile payment systems.

Finally, ease of use and perceived security, with great influence on intention to use, also have a significant relationship. We believe that ease of use has lesser importance because users are highly comfortable with mobile telephony and its uses as revealed in the introduction to this document. Moreover, perceived security has a small but significant influence (except in the QR model) in the intention to use the mobile payment systems analyzed. This variable, not included in TAM, has been included in numerous investigations and in our case was also justified as important as consumers with a higher level of perceived security show a greater propensity to accept and adopt new mobile payment systems.

On the other hand, it is worth noting that the differences detected between the three mobile payment systems reinforce the idea that consumer behavior differs depending on the type of mobile payment system, as seen through the difference of intensity in the different constructs. In our case, we have observed differences in the levels between subjective norms and perceived usefulness, subjective norms and intention to use, perceived usefulness and attitude, perceived ease of use and perceived usefulness, and finally, perceived ease of use and attitude. Consequently, the only relationships that did not show significant differences were perceived usefulness and intention to use, attitude and intention to use and perceived security and intention to use (although in the latter case the QR mobile payment system relationship was not significant). This suggests that usefulness, attitude and self-perceived security are also clear determinants of intention to use mobile payment systems.

6.2. *Practical implications*

Use of mobile payment systems is becoming increasingly frequent and consumers are beginning to accept it (Oxford Economics et al., 2017). Technology companies, mobile operators and financial institutions, are only some of the industries that are already working on a variety of strategies and technologies to make mobile payments become part of everyday life in the very near future.

Payments made through mobile phones are one aspect leading to important changes in international trading due to the accessibility that this technology provides. This adoption is evident even in developing countries like Kenya and India, which lead over other developing countries in mobile payment use. In developed countries, however, this type of payment system is altering the “status quo” of historic financial intermediation. For these reasons, and yet undeveloped potential, mobile payment systems will feature heavily in the future and be used by

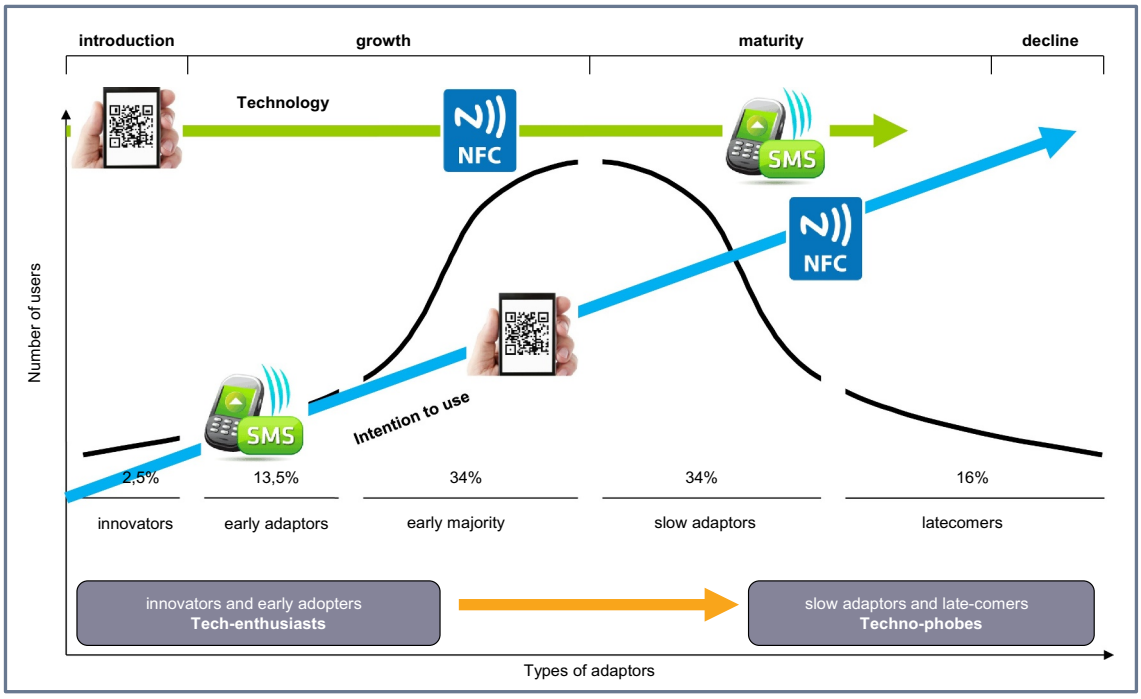

Fig. 3. Model of innovation-adoption of technological innovations/categories of adopters.
Source: Authors, based on Muñoz (2008).

all parties that are active elements in trade. It seems logical that the dynamism, globalization, customers and competitors will define the future scenario of mobile payment systems.

It is important to note that innovation and change are not limited to just mobile payments, but any type of terminal handling “money” and this allows any payment to be made at any time of day, from any location in the world, so the perceived value by the user is multiplied.

If the Diffusion of Innovation theory (Rogers, 2003) is applied to the current status of each of the technologies presented, SMS technology would be in the laggards stage, NFC technology in the early adopter stage and the incipient QR mobile payment technology would be in the innovator stage as shown in Fig. 3. This finding would suggest a priori greater acceptance of SMS technology, followed by NFC and finally QR technology, precisely because the public seems to have the most knowledge about it, but our research has shown a different conclusion.

In fact, the degree of adoption of an innovation is related to the time needed for a new product to be adopted by members of the social system, i.e. the speed with which those who adopt a product accept it (Muñoz, 2008). In other words, the time needed for adoption of an innovation tends to be increasingly reduced in today's society.

In our case, the mobile payment system a priori that should have resulted in the greatest intention to use, based greater widespread knowledge, is the SMS mobile payment system. However, it was proven to be the system with the lowest intention to use, while the most recently developed QR mobile payment system had a level of intention to use, similar to NFC technology, even though the latter was better known.

Therefore, according to the results obtained from our research, companies interested in developing their strategies regarding the implementation of mobile payments tools such as the NFC chips and the QR codes, should approach the opinion of the individuals that customers have as a reference as a critical factor regarding the adoption of mobile payment systems. Marketing events taking place in either real or virtual social networks might also constitute a significant strategy towards the intention to adopt. However, companies should first introduce a robust, reliable mobile payment system that would meet the expectations of potential customers, especially technology enthusiasts.

In this sense, technology enthusiasts are usually the first to adopt new technologies and eventually trigger their mass adoption. These users are highly regarded by their peers, enthusiasts successfully adopting and accepting the new ideas reduce the underlying uncertainty associated with the new technology. In addition, the subjective opinions of technology enthusiasts on a certain innovation transfer over to their closest peers through interpersonal networks (Rogers, 2003).

Therefore, if a particular payment system captivates the attention of users who are regarded as a reference by their peers in a large social network then it will likely have a high chance of successful adoption by the rest of the users. This finding greatly influences the success of mobile payment systems as a whole. Because our relationship with money is deeply personal, payment habits change slowly—but they can and do change (Oxford Economics et al., 2017). The road to a future of safe and speedy mobile transactions begins with trust and the reference people of a particular individual can start this process of trust.

Results obtained also identify consumers' perceived usefulness of a payment system as a critical factor determining its successful, mass adoption. This study also confirms the belief that companies should focus on developing payment tools surpassing the perceived usefulness of those traditional payment systems already implemented in the different markets. The use of mobile payment systems is not only relying on its innovativeness; there are other key factors such as their usefulness, speed, convenience and advantages that could lead consumers to use them over other traditional solutions (cash, credit cards, etc).

This research also finds perceived security as a significant factor when approaching SMS and NFC m-payments. Even if this was not fully expected in the first place, it is true that perceived security is usually at the top of the highest regarded factors when approaching future users of mobile payment technologies through qualitative studies and open-ended research (Goeke and Pousttchi, 2010). In this regard, we can state that consumers' perceived security is indeed a critical factor that should be always tackled in the very first place when designing strategies for the adoption of new payment systems.

We recommend that companies interested in the implementation of mobile payment systems focus on developing tools with an appropriate

set of features for financial applications, including security. They need to harness the technology's potential for delivering the security, convenience, and rewards that consumers have come to expect from a payment system. For that, they need to review their assumptions about consumers' payment preferences in security field and reassure their customers that mobile wallets come with the same indemnification as old-school credit cards, and with greater protection against theft.

On a side note, since the market already has different actors and competitors with the intention to develop a tool that would be adopted by the majority of consumers, the different strategies that companies interested in mobile payment systems should approach when developing a new technology are also a significant influence. As den Uijl and de Vries (2013) reported, by building the appropriate partnerships and also approaching the key drivers of the adoption of a major technology in a certain business sector, a company could eventually achieve both success and control over the world's technological market. When it comes to mobile payment systems, all these findings suggest that building wide partnerships while offering a technology that would comply with the different criteria proper of the different partners would result in a competitive advantage with a suitable implementation of the new service. Trying to achieve this advantage is one of the main challenges that the market of mobile payment systems is facing.

6.3. Limitations and future research opportunities

As this study focuses on a comparative analysis of three innovative mobile payment systems in a sample of Spanish consumers, we are aware that the scope of the study is its principal limitation. However, we consider it relevant as none of the technologies discussed are well developed in the reference country. Despite this, the findings can be applied to other countries in situations similar to those in Spain.

In this respect, it is worth noting that the profile of the respondents might influence the results of the study, future researches should consider approaching different profiles in order to extend and broaden the scope of the sample.

In addition, to provide greater external validity of the results and verify the statements in the previous section, a comparison study of the different payment systems described above could be carried out in different countries with a different level of technological developments in order to define independent profiles of each type of mobile payment.

On a related note, future studies could approach the same data collection procedure employed in this research to avoid possible methodological concerns.

Furthermore, since the market is changing so rapidly, new mobile payment systems could also be analyzed, such as biometric fingerprint or voice payments or even the more modern Google Goggles.

Finally, future studies will include potential determining or modifying factors such as gender, age and even the grade of experience with similar payment devices or new variables such as satisfaction, quality, etc. (Zhou, 2013).

Acknowledgements

This study is being conducted with the financial support received from Excellence Research Project P10-SEJ-6768 of the Andalusia Regional Government and The Capes Foundation, Ministry of Education of Brazil (BEX 0739/13-8).

Appendix A. Questionnaire

Construct	Items	References
Attitude towards SMS/NFC/QR payment systems	The use of an SMS/NFC/QR mobile payment system is a good idea. The use of an SMS/NFC/QR mobile payment system is convenient. The use of an SMS/NFC/QR mobile payment system is beneficial. The use of an SMS/NFC/QR mobile payment system is interesting.	Yang and Yoo (2004); Schierz et al. (2010)
Intention to use SMS/NFC/QR payments systems	Given the opportunity, I will use a mobile SMS/NFC/QR payment system. I am likely to use a SMS/NFC/QR payment system in the near future. I am open to using an SMS/NFC/QR mobile payment system in the near future. I intend to use an SMS/NFC/QR mobile payment system when the opportunity arises.	Davis (1989); Gefen et al. (2003a, 2003b); Venkatesh and Davis (2000); Schierz et al. (2010)
Perceived usefulness of SMS/NFC/QR payment systems	The SMS/NFC/QR mobile payment system is a useful mode of payment. Using a SMS/NFC/QR mobile payment makes the handling of payments easier. A SMS/NFC/QR mobile payment system allows quick use of mobile applications (for example, ticket purchases, use of mobile coupons, etc.). I believe that an SMS/NFC/QR mobile payment system improves my consumer decisions (providing flexibility, speed, etc.)	Bhattacherjee (2001); Schierz et al. (2010)

Perceived ease of use of SMS/NFC/QR payment systems	It is easy to become skillful at using an SMS/NFC/QR mobile payment system. Interaction with an SMS/NFC/QR mobile payment system is clear and comprehensible. It is easy to follow all the steps of a SMS/NFC/QR mobile payment system. It is easy to interact with a SMS/NFC/QR mobile payment system.	Bhattacherjee (2001); Davis et al. (1989); Taylor and Todd (1995); Venkatesh and Davis (2000); Schierz et al. (2010)
Perceived security of SMS/NFC/QR payment systems	The risk of an unauthorized party intervening in the payment process is low. The risk of abuse of consumer information (e.g., names of business partners, payment amount) is low when using a SMS/NFC/QR mobile payment system. The risk of abuse of billing information (e.g., credit card number, bank account data) is low when using a SMS/NFC/QR mobile payment. I would like SMSNFC/QR payment systems to be safe and secure.	Parasuraman et al. (2005); Schierz et al. (2010)
Subjective norms	People who are important to me recommend using SMSNFC/QR mobile payment system. People who are important to me view the SMSNFC/QR mobile payment system as beneficial. People who are important to me think it is a good idea to use SMSNFC/QR mobile payment systems.	Taylor and Todd (1995); Venkatesh and Davis (2000); Schierz et al. (2010)

Appendix B. Demographic profiles of the respondents

Variable	Category	Mobile payment system					
		SMS		NFC		QR	
		n	%	n	%	n	%
Gender	Male	145	50,5	120	41,8	87	51,8
	Female	142	49,5	167	58,2	81	48,2
	Total	287	100	287	100	168	100
Age	< 18 years	0	0	1	0,3	0	0
	18–24	138	43,9	126	43,9	66	39,3
	25–34	65	27,5	79	27,5	44	26,2
	35–44	50	15,3	44	15,3	40	23,8
	45–54	15	8,7	25	8,7	16	9,5
	55–64	10	2,4	7	2,4	2	1,2
	> 65 years	9	1,7	5	1,7	0	0
	Total	287	100	287	100	168	100
Studies	No education	5	0,3	1	0,3	1	0,6
	Primary (elementary/middle school)	15	4,2	12	4,2	0	0
	Secondary (high school)	70	27,2	78	27,2	20	11,9
	University (undergraduate)	162	52,3	150	52,3	107	63,7
	Postgraduate	34	16	46	16	40	23,8
	DK/NA	1	0,3	1	0,3	0	0
	Total	287	100	287	100	168	100

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