Adoption factors of NFC Mobile Proximity Payments in Italy

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ABSTRACT
Mobile payment represents a promising emerging market. Nevertheless, especially for Mobile Proximity Payment (MPP), neither users nor merchants have largely adopted this innovation so far. This study aims to identify the adoption factors of MPP by developing a user model, tested through an in-lab experimentation involving 50 users in Italy. We then compared our results with those obtained through a remote survey that involved 1001 subjects who have never used a MPP system before. Compatibility with users' needs, habits and lifestyle has been found to be the dominating factor for adoption. Surprisingly, we found that a previous use of e-payment systems does not influence the user's perception of compatibility. While perceived security is a concern for prospective users who have never used MPP, it does not affect the intention to adopt for users who tried the system at least once. Cost considerations do not influence MPP adoption intention. Based on these findings we expect that MPP systems have a high chance to be widely adopted if optimized for compatibility.

Author Keywords
User Experience; M-payments; Security; Risk.

ACM Classification Keywords
H.5.2. User Interfaces: Evaluation/methodology.

INTRODUCTION
Mobile Payment is an emerging and promising technology. The scientific literature reports a number of definitions of "mobile payment" [5, 20, 24, 26, 30, 43]. Some include any wireless device, others refer to a transaction made through a cell phone, smartphone, or tablet, without mentioning other wireless devices such as key chains or watches. Moreover, in recent years a number of solutions where the smartphone acts as the acceptance device (mobile POS) appeared on the market. In this work, we refer to mobile for performing payment on the user side and consider only payments made via smartphone. This is because the user experience strongly depends on the device in the user's hands. What we intend to investigate is the experience the user has in making a payment through a device not only equipped with wireless connectivity, but also with an advanced User Interface.

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A commonly accepted classification is mobile remote and proximity payments [10, 20]. Mobile Proximity Payments occur when the payer and the payee are physically located in the same place. These are typically in-store payments. The communication between the user's smartphone and the merchant's device is via short-range wireless technologies, such as Near Field Communication (NFC) [13, 17]. While mobile remote payments are widely available and users are getting used to them, the in-store proximity payments are still in their infancy. However, this situation can be expected to change quickly with the introduction of new services like Apple Pay. MPP therefore represents a huge business opportunity in the upcoming years. Visa believes that by 2020 more than 50% of contactless transactions will be made with mobile devices, while many operators assume that NFC represents the fourth wave of revenue after voice, text and data bundles [27]. Italy is an interesting market due to a very high mobile phone penetration. According to the International Telecommunication Union [18] mobile subscriptions in Italy were about 97 million in 2013, corresponding to a penetration of about 159% in the population. On the other hand, electronic payment system usage is still low, with 34.4 operations per capita made through payment cards compared to a European average of 82 [6]. Given these conditions, MPP can be a great opportunity to reduce the circulation of cash and the costs associated with it, moreover increasing payment traceability and reducing the informal economy.

A key issue to address to increase m-payment adoption is the acceptance of these services by consumers. There is a growing body of research on adoption factors in different countries: USA [15], Uganda [16], India [19], Spain [24], Finland [25], Germany [34], UK [37], Malaysia [38], and China [42]. Slade et al. [36] conducted an extensive literature review on m-payment, m-commerce and m-banking adoption factors: among the 73 studies analysed, none is from Italy. Due to the opportunity MPP can represent in such a country and to the lack of studies related to user adoption, our objective is to develop and validate a user model for the adoption of MPP in Italy and to verify if different types of survey can lead to different feedbacks from users.

The paper is organized as follows. First, we provide an overview of the literature on technology acceptance. Following this, we present the proposed user model and describe the research hypotheses underlying our work. We then define the research method, followed by the analysis of data collected. Finally, we present our key findings, theoretical and practical implications, as well as limitations and future research suggestions.

THEORETICAL BACKGROUND

In order to investigate the determinants of users' intention to adopt an IT system, a number of models have been developed in the scientific literature. The majority originate from the theory of reasoned actions (TRA) [3] and the theory of planned behavior (TPB) [1, 2].

Based on TRA and TPB, Davis [12] developed the technology acceptance model (TAM). According to TAM, the two main factors that influence users' intention to adopt a system are the perceived ease of use and the perceived usefulness. Davis defined the perceived ease of use as *the degree to which a person believes that using a particular system would be free from effort*, and the perceived usefulness as *the degree to which a person believes that using a particular system would enhance his or her job performance*. The model, revised and extended also by Davis himself, was originally developed for studying the use of technologies in the workplace, but it was later applied to many other areas, including e-commerce [14, 22, 31], Internet banking [23] and mobile payment [10].

Another significant theory to determine how people can react to innovation is the innovation diffusion theory (IDT), introduced in 1962 and refined by Rogers in 1995 [33]. IDT aims at predicting the degree to which an innovation could be adopted by different targets. Rogers defined five predictors that explain between 49% and 87% of the variance in the rate of the adoption of an innovation: relative advantage, compatibility, complexity, trialability and observability. Some studies on mobile payment adoption used IDT as the reference framework [19, 25].

In 2003 Venkatesh et al. [40], proposed the unified theory of acceptance and use of technology (UTAUT), which combines the original TAM with seven other models, including the IDT. The UTAUT identifies four key elements that determine the user's intention to adopt a system and the actual use of it: performance expectancy, effort expectancy, social influence and facilitating conditions. Moreover, UTAUT considers four moderation variables, gender, age, experience and voluntariness of use, which are supposed to have an indirect impact on the behavioral intention. UTAUT has been used to investigate adoption factors in different fields. Carlsson et al. [8] used the model to determine the adoption of mobile devices and services, while Chen and Chang [11] referred to it to investigate the user acceptance of NFC mobile phone services.

USER MODEL AND RESEARCH HYPOTHESES

User model development

The proposed user model has been defined by drawing both on the most used and validated models referred to a generic IT system [3, 12, 33, 40] and on the more specific analyses related to e-commerce, m-commerce, and m-payment adoption factors [14, 22, 25, 31, 32, 34, 41, 42]. In more detail, we pointed out the most commonly used factors to determine user's intention to adopt a system from the examined works, equating factors that have a similar meaning, such as perceived ease of use [12], complexity [33] and effort expectancy [40]. We then analyzed the predictive power of each of the observed factors according to the reference literature, in particular in the areas closest to the topic of investigation, to determine which dimensions to include in our model.

The result is a revised TAM extended with *perceived security, risk* and *trust* as suggested by several studies on payment adoption [14, 22, 31, 34, 41, 42], *perceived cost* [25, 41, 42] and *compatibility*, which has been found to be the most significant predictor of the intention to use MP services in different contexts [34, 41]. These three variables, together with the original TAM constructs, *perceived ease of use* and *perceived usefulness*, are among the most frequently used and validated factors influencing behavioral intention in the mobile payment field, as shown also in the analysis conducted by Slade et al. [36].

Research hypotheses

Perceived ease of use (PEU) – PEU has been considered as a determinant of behavioral intention by several studies [12, 14, 22, 31, 34]. It includes, among others, the ease of registering for the service, the number of steps needed to perform the required action, the clarity of the instructions, and the user enjoyment in using the system.

H1 – PEU positively affect the intention to adopt a NFC MPP system.

Perceived usefulness (PU) – PU is recognized by a large number of studies as a fundamental determinant of user's intention to adopt a system [12, 14, 34, 41]. It is related to the possibility of gaining a real advantage by using the system. For MPP, it may relate to saving time or getting rid of the need to carry coins or wallet when paying.

H2 – PU positively affect the intention to adopt a NFC MPP system.

Perceived security (PS) – Security is an important variable when dealing with payment systems, as it can often determine the user's decision to buy a product or not [14, 22, 34]. In our study, we consider security as composed by both perceived risk and trust. Therefore, perceived security is related, among others, to the risk associated to the transaction, as well as to privacy concerns, and confidentiality of data.

H3 – PS positively affect the intention to adopt a NFC MPP system.

Perceived cost (PC) – When a person wants to adopt an innovation, usually he has to pay some costs for it. Cost is related both to the money needed to buy a new device or subscribe to a service, and to non-monetary costs (e.g. health risks and data security) associated with the use of a system [4]. In our work, we consider only the monetary cost to buy a new NFC device, as all the issues related to security are included under the previous construct. Some studies found perceived cost to have a direct effect on consumer adoption [32, 41], while others found that the effect of perceived fee on behavioral intention is stronger for potential adopters rather than for actual users [42].

H4 – PC has a slight negative effect on the intention to adopt a NFC MPP system.

Compatibility (C) – In order to make a person to adopt an innovation, it is very important that the innovation is compatible with his/her habits and lifestyle [15, 34, 41, 42]. In regard to mobile payment, it is likely that a person who is already using electronic payment systems will be more favorable to the adoption of mobile payment. People who have never used an electronic payment system, will hardly adopt a mobile payment service, although it is easy to use and has no usage costs.

H5a – Previous use of electronic payment systems has a positive effect on compatibility.

H5b – Compatibility has a strong positive effect on the intention to adopt a NFC MPP system.

Another hypothesis underlying our study is that consumer decision to adopt a MPP or not is influenced by different variables depending on the type of survey conducted and on the level of user's engagement with the system. Answers given to a survey in which the user does not have the possibility of interacting with the system may vary from those given after a real interaction with the actual system.

H6a – The users who tried a NFC MPP system are more inclined to adopt it compared with those who did not try it.

H6b – The users who tried the system overtake more easily their concerns about security compared with those who did not try it.

RESEARCH METHOD

To determine how users' answers may change according to the type of survey, we compared the results from a group of 50 subjects who interacted with a NFC MPP system with the answers given to a remote survey by a sample of 1001 subjects representative of the Italian population who had never interacted with any MPP system.

Instruments and Samples

The remote survey consisted of a set of closed-ended questions about perceived advantages and disadvantages of mobile payment that were submitted to a sample representative of the Italian population via Computer-Assisted Telephone Interviewing (CATI) [7, 9].

The in-lab survey followed the procedure recommended by usability researchers [21, 28, 29]. After listening to the test introduction, the user filled in an entry questionnaire with demographic data, and with information on e-payment usage. Then the user received a NFC mobile phone with a payment application installed. The user is then asked to perform three tasks: to register a new account, to register a payment card and to perform a payment. For this last task, the researcher acts as a merchant with an NFC tablet as the acceptance device. To collect users' answers after the use of the NFC MPP system, we designed a questionnaire composed of a set of items derived from the scientific literature and adapted to the specific features of the mobile payment system. After a pre-test phase, users' suggestions led to the development of a 26-item questionnaire. Some of the statements were positively worded (e.g. *it is easy to register for the system*), while others were negatively worded (e.g. *there are too many steps required to complete the transaction*). Table 1 shows the sample involved in the in-lab survey, profiled according to socio-demographic and vertical variables.

		N	%
Gender	M	30	60,00%
	F	20	40,00%
Age	18 – 24	6	12,00%
	25 – 34	14	28,00%
	35 – 54	12	24,00%
	45 – 64	9	18,00%
	55 – 64	9	18,00%
Center width	< 10.000 residents	0	0%
	10.000 – 30.000	2	4,00%
	30.000 – 100.000	10	20,00%
	> 100.000 residents	38	76,00%
Use of electronic payment instruments	Never	1	2,00%
	Less than once per month	3	6,00%
	At least once a month	9	18,00%
	One or more times a week	35	70,00%
	At least once a day	2	4,00%
Type of instrument	Credit card	15	30,00%
	Debit card	21	42,00%
	Prepaid card	13	26,00%
Knowledge and use of NFC technology	I know it and I used it	6	12,00%
	I know it, but I never used it	22	44,00%
	I don't know it neither I used it	22	44,00%

Table 1 - Subjects profiling according to socio-demographic and vertical variables

DATA ANALYSIS AND RESULTS

On the data collected after the in-lab survey, we first performed reliability analysis through the Cronbach's alpha, then tested the proposed hypotheses through standard linear regression. We used SPSS 20 as the analysis tool.

One of the advantages of collecting data through an in-lab experimentation is that the researcher can observe the user both during the interaction and while he is responding to the final questionnaire, in this way obtaining additional information beyond the ones than can be inferred from the

mere data analysis. Some researchers argue that it is better to leave the user alone while he is filling in the questionnaire in order to decrease social desirability bias [39]. We believe that if the researcher maintains a detached attitude, but he remains at the user's disposal in case of doubts, the biases due to misinterpretation by the user can be easily detected and corrected. So, in performing data analysis, statistical results were balanced with researcher's observations during the test. This is a new perspective brought by our study compared to the methods adopted by other works in this field [24, 34, 37, 42].

To check the internal consistency of each construct, we performed the Cronbach's alpha test. We analyzed the Cronbach's alpha of each construct and the correlation of each item with other items composing the scale. For PEU, we found that *PEU3 - It is easy to receive the transaction details* and *PEU4 - There are too many steps required to complete the transaction* had a low item-total correlation score (0.244 and 0.296). In fact, a fair number of users claimed they did not notice transaction details (e.g. merchant and payment amount) during the interaction, but this did not affect the total PEU. After refining the scales, all constructs achieved high (0.70 – 0.90) Cronbach's alpha values, the lowest being PS (0.745) and the highest being PU (0.830). We then weighted the remaining items by assigning to each of them a score between 0 and 1, according to their importance in determining the final score, as a result of the researcher's observations and of the reliability analysis. As an example, in line with other studies [35], we found that users had some difficulties in interpreting the negatively-worded items, so we assigned a lower value to them.

By analyzing Pearson correlations between each pair of variables, we found that the intention to use a MPP system (INT) is positively correlated with C (r =0.751, p <0.001) and with PU (r =0.645, p <0.001). INT is positively correlated also with PEU (r =0.395, p =0.005). PS and PC correlations with INT do not reach statistical significance. The analysis of the correlations between dependent variables shows that PU is positively correlated with PEU (r =0.456, p =0.001) and with C (r =0.606, p <0.001).

To test the proposed hypotheses, we performed a standard linear regression analysis. The five predictors account for an overall variance of about 60,7%. The F-test shows that the null hypothesis that none of the predictors is related to the intention to use a mobile proximity payment system can be rejected (F (5,44) = 16.12, p < 0.001). The analysis of regression coefficients confirms that compatibility has the strongest impact on the intention to use the system (B = 0.477; β = 0.561), followed by perceived usefulness (B = 0.218; β = 0.225) and perceived ease of use (B = 0.181; β = 0.164). Perceived security and cost do not influence the intention to adopt a MPP system.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	40,237	5	8,047	16,123	,000[b]
	Residual	21,962	44	,499		
	Total	62,199	49			

Table 2 - ANOVA

Model **Adjusted R^2 0.607**		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity statistics
		B	Std. Error	Beta			VIF
1	(Constant)	,814	,755		1,078	,287	
	COM	,477	,100	,561	4,760	,000	1,733
	PU	,218	,121	,225	1,798	,079	1,957
	PEU	,181	,113	,164	1,604	,116	1,297
	PC	,042	,054	,071	,764	,449	1,066
	PS	,018	,095	,018	,187	,852	1,129

Table 3 - Coefficients

DISCUSSION AND CONCLUSIONS

Key findings

This study investigated the user acceptance of NFC MPP services by analyzing the relationship between five variables that are supposed to influence the intention to use a MPP system according to the existing literature. To validate the proposed model, we performed an in-lab test involving 50 users. We then compared the in-lab test results with those obtained through a remote survey on a sample representative of the Italian population to verify if different types of survey can lead to different feedbacks from users. Following are the main findings of the research.

1. The variable that had the highest impact on the intention to adopt the system is the compatibility with users' needs, habits and lifestyle. This is in line with other previous studies conducted mature markets such as USA [15], Germany [34], and China [41]. Age and/or previous use of electronic payment systems do not influence users' perception of compatibility: a user can evaluate MPP in line with his/her lifestyle even if he/she does not make a frequent use of e-payment systems. In reference to our proposed hypotheses, we can affirm that H5b is supported, while H5a is not.

2. The positive relationship between perceived usefulness and intention to use a MPP system, which has been highlighted in various studies realized in India [19], Germany [34], and UK [37], was confirmed also by our analysis, thus supporting H2. For MPP, one of the features that largely determines the PU is the speed of payment: the more the users perceive that the transaction time is shorter than other types of payment, the more they find the system useful and so they are likely to adopt it.

3. Perceived ease of use has a moderate positive effect on usage intention. Its predictive power is lower than that of compatibility and perceived usefulness, but it is still not entirely negligible, thus supporting H1. Most of the existing literature found PEU to have an indirect effect on the adoption intention, mainly through the mediating construct of PU [22, 41]. According to Lee et al. [22] we can affirm that, as the majority of the subjects involved in the study

were quite knowledgeable about smartphone usage, the PEU was in line with that of the interactions they were used to, so ease of use has not been a significant determining factor on the intention to use the proposed system.

4. Perceived security do not seem to affect the intention to adopt a NFC MPP service for users who tried the system, thus rejecting H3. This result deserves a deeper analysis. During the interaction, a fair number of subjects raised the issue of security, asking for more information about it, since in their view the application did not provide sufficient details about security of payment data and transaction procedure. To increase perceived security, users suggest to include in the app a well-known payment brand, such as Visa or MasterCard logo. Nevertheless, even if users have raised issues on security, demonstrating attention for the topic, the alleged lack of security information does not affect the final decision to adopt the system or not. Although we have tested the system in ideal conditions, our results are consistent with those obtained in a real environment, both in Malaysia [38] and India [19]. This is an interesting finding, as for non-users the concerns about security were the main reason why they claimed to be not interested in adopting a MPP solution. 37,66% of the respondents to the remote survey declared to be afraid that this type of payment can be not safe enough, while 25,87% complains about a general lack of confidence in the system [7, 9]. The strong negative effect of perceived risk for people who have never used a NFC MPP system is confirmed also by Slade et al. [37]. These findings give support to H6b.

5. Perceived monetary cost has a negligible effect on the intention to adopt a MPP system: the users do not care about the cost of upgrading the device. This can be mainly because people are used to frequently change their device, at least in countries like Italy, where the smartphone penetration has reached very high levels. In reference to our model, H4 is not supported.

6. The general predisposition towards the use of a MPP system change according to the type of investigation conducted. In the remote survey, the majority of the respondents (60,14%) declared to be not at all inclined towards the use of a MPP system [7, 9]. On the other side, the subjects involved in the laboratory scenario have proven much better disposed towards the use of smartphone to make in-store payments: the INT score mean was 5.92 and the median was 6.35 on a 7-point scale. This supports H6a.

Research implications

Theoretical implications – In terms of theory building, our research supports the importance of compatibility, perceived usefulness and perceived ease of use on adoption intention of NFC MPP. Moreover, through the comparison of the two investigations, it confirms that security is a determinant factor only for non-users. Yet, in response to the call for studies focused on specific types of mobile payments [15], our research offers an insight on NFC-based proximity payments. Finally, since while observing users we found that they had some concerns in interpreting negatively-worded items, this gives some suggestions on how to design questionnaires to avoid misinterpretations.

Practical implications – Our findings provide also important practical implications for designers and developers of MPP applications, as well as for management.

First, they reveal that service providers need to increase individuals' perceptions on security of MPP. While other MPP features such as the speed of payment are well perceived also among non-users, suggesting that this feature is adequately communicated, security is still unperceived by people who have never used a MPP system. To overcome this issue, managers can give users the possibility to try the technology before adopting it, for example through a free 10€ card that can be used before registering a real card, as it happened with the launch of Google Wallet in the USA. Once tried the system, the perceived risk is no longer relevant to the adoption decision. This is a critical insight given the huge focus of the payments community on trust marks, perception of trustworthiness, and usable forms of security. Our findings highlight that, while people look for these features of technology, they are willing to trade off this sense of security for making their life easier.

Second, as the speed of payment is the main determinant of PU, it is important to design mobile payment applications that are faster compared to alternative payment methods. Although it should be a good practice suggested by common sense, there is a number of MPP applications that require too many steps to complete the payment (e.g. open the app, select the card, activate the payment mode, draw up the phone to the POS, insert the PIN code) thus becoming inconvenient compared with alternative payment methods. Based on our findings we believe that it is worth giving up a bit of perceived security asking less confirmations to keep the interaction as smooth and fast as possible. Moreover, as many people use one single card for the majority of their payments, it can be useful to implement a "default payment mode" that uses a pre-selected card, thus avoiding to ask the user to select the card before each transaction.

Third, we found that another important aspect to determine user's adoption is the ease of registering for the service, which largely determine the perceived ease of use. This is an often overlooked aspect when designing mobile payment applications: a number of them, in fact, ask the user not only to change the smartphone, but also to change his SIM card to obtain a new NFC-enabled one, and to request the issue of a new payment card, as the ones he already owns are not suitable for the service. This kind of actions discourage even a motivated user to register for the service, creating a strong barrier to the adoption.

Limitations and future research

This is a first study that empirically tests predictors of user acceptance of MPP services through an in-lab experimentation rather than a remote survey. One limitation

of the in-lab tests is that, due to reasons of time and cost, numerically limited samples can be involved, allowing only certain types of analysis. With a numerically larger sample, composed by 100–150 subjects, it would be possible to perform other types of analysis, such as confirmatory factor analysis to test whether the data fit the hypothesized user model.

Our study shows that MPP has a very high chance of user adoption also in countries with a low electronic payment systems usage like Italy, if supported by brands that have high lifestyle compatibility and can create trust. From this perspective newly available payment systems like Apple Pay should be expected to thrive from the point of view of user adoption if they are introduced by more and more merchants.

As the proposed model explained about 60% of the variance in NFC MPP adoption intention, there can be other predictors not included in the analysis able to increase its predictive power in further studies. One could be *Subjective Norms (SN)* [3], as recent studies on MP adoption found them significant for adoption decision [15, 37, 42]. Other suggestions for future research include testing the model in other countries to see if cultural differences, as well as MPP services spread, can influence the users' answers. Moreover, it might be interesting to use other MPP applications, not NFC-based, to see if users' answers can be generalized to a wide range of different MPP applications. Finally the work can be extended to other mobile security applications including digital identity management, an area in which more research and development efforts have been highly recommended by experts [38].

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