What Influences Consumers' Intention to Use Mobile Payments?

Key Pousttchi, Dietmar G. Wiedemann
Mobile Commerce Working Group, Chair of Business Informatics and Systems Engineering, University of Augsburg, 86135 Augsburg, Germany
{key.pousttchi, dietmar.wiedemann}@wi-mobile.de

Mobile payments represent an extremely interesting paradox in the world of mobile telecommunications, still not showing success in most markets. Customer acceptance turned out to be a decisive factor. In order to gain a deeper understanding of consumer behavior this paper introduces a consumer acceptance model that addresses perceived usefulness, perceived ease of use, subjective security, and task-technology fit. Our empirical research was conducted online operating as a mix between an experiment and an online survey instrument to measure the constructs. The research (N = 1104) confirms findings from technology acceptance and task-technology fit literature, whereas subjective security was not confirmed as driver of mobile payment acceptance.

1 Introduction

Serious efforts have been made to use mobile phones for business-to-consumer payment transaction processing in the last ten years. This type of processing is referred to as *mobile payment* or *m-payment*. For the purposes of this paper, mobile payment is defined as a type of payment transaction processing in the course of which – within an electronic procedure – the payer (at least) uses mobile communication techniques in conjunction with mobile devices for initiation, authorization, or completion of payment [Pous03]. The first mobile payment efforts originated from the fact that the mobile phone – due to its specific properties, its wide distribution in the population, and its consumers' behavior – is especially well suited for payment activities (e.g., [Herz03]). In addition to the attractiveness of the technology, the appearance of mobile services and mobile commerce with 2.5G networks by the end of the 1990s made it essential to develop an appropriate form of settlement that possesses the same properties, especially ubiquity, as the mobile offers for which billing occurs.

For the examination of mobile payment procedures, two *basic scenarios* must be distinguished. *Inside m-commerce,* payment for mobile services must be implemented in a way that ideally will be perceived by the consumer as a seamless part of the system. *Outside m-commerce*, mobile payment itself becomes a mobile service which provides payment functionality in various scenarios. These scenarios include payment in stationary Internet/e-commerce, payment at vending machines (often called "unmanned point-of-sale (POS)"), payment to a person acting as a merchant or service provider ("manned POS", for example,

the cashier in a department store, the pizza delivery person or the taxi driver), and money transfer between consumers. As a result, five general *payment scenarios* can be distinguished, a categorization that goes back to [KrPT02] and is refined in [Pous03]: Mobile Commerce (MC); Electronic Commerce (EC); Stationary Merchant Automat (SMA); Stationary Merchant Person (SMP); and Consumer-to-Consumer (C2C). In this study, we especially focus on the SMP and SMA scenario.

According to the unanimous forecasts of the years 1999/2000 mobile phones should by now have been firmly established as payment terminals in the most diverse fields. However, whereas merchants and mobile payment service providers made a multitude of attempts to offer respective services, absence of wide consumer acceptance of the offered procedures prevented a market breakthrough in most markets up to now (e.g., [TaKa04]).

Several mobile payment trend studies have revealed the potential of mobile network technologies for payment purposes [Spee01] [Mobi04] [TaKa04]. However, there exists a need for more substantive, theory-based research and a deeper understanding of consumer behavior with regard to mobile payment. This study aims to explore and model the central consumer perceptions that affect the decision to use mobile payment procedures. In particular, we study whether the Technology Acceptance Model (TAM) [Davis89] describing consumer acceptance of technology offers comprehensive explanation for consumer decisions related to adoption of mobile payments. TAM has proven to be a useful theoretical model in helping to understand and explain use behavior in information system implementation. However, Legris et al. have detected heterogeneous results regarding the constructs of TAM and propose that these may result from systematic factors left out and not present in constricted experimental settings with student subjects [LeIC03]. Thus, it is important to include other explaining variables into TAM. As seen later, relating to mobile payment, the context in which mobile payment is used and consumer's perceived security (defined later as subjective security) seem good candidates in the sense of Legris et al. and thus are included in our proposed model.

The paper is organized as follows: In Section 2, we propose the research model. Section 3 offers the details of the method used in this paper. In Section 4, we present and discuss our results. Finally, we conclude with a discussion of the results and a consideration of managerial and research implications in Section 5.

2 Research model

Given that a mobile payment procedure is both an information technology and a channel which consumers use to pay, technology-based and security-based antecedents should work together to influence the decision to accept a particular mobile payment procedure. Further on, some studies showed that the acceptance of mobile payment varies with the context in which a consumer is able to use a mobile payment procedure (e.g., [KhPW03]). These issues are addressed in our research model depicted in Figure 1. The next sub-sections elaborate the theoretical framework and derive the hypotheses.

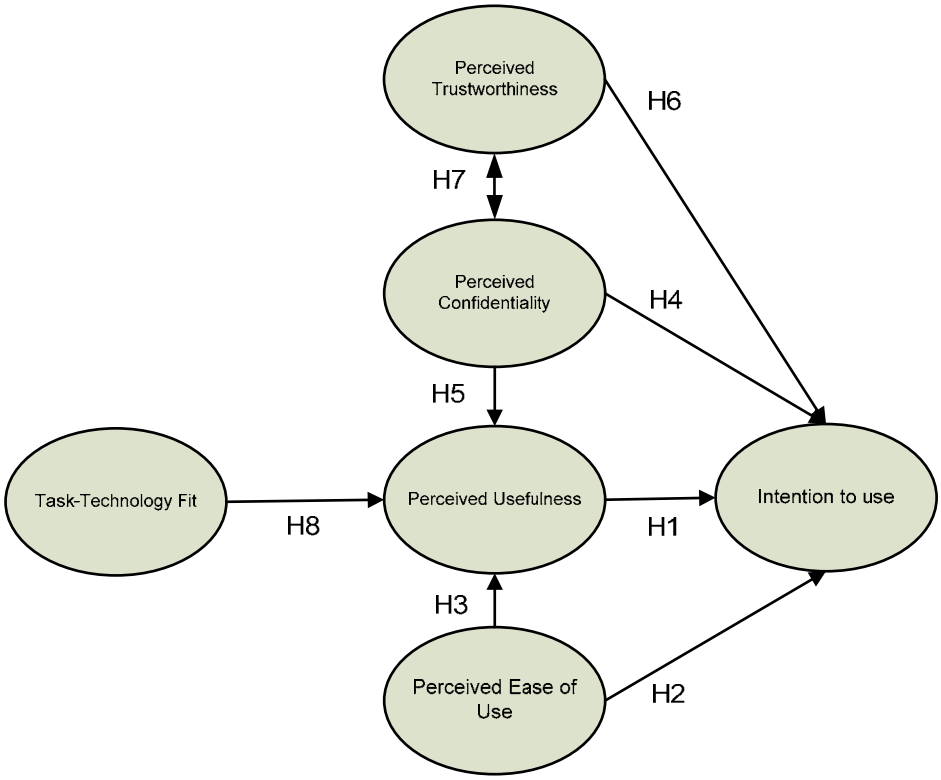

Figure 1. Research model

2.1 Technology Acceptance Model and Mobile Payment

A mobile payment procedure is, in essence, an information technology. As such, intentions to use mobile payment procedures should be explained in part by the TAM introduced by Davis [Davi89]. Moreover, these procedures are functional services adopted for utilitarian reasons [KhPW03]. Thus, the model was chosen as an appropriate basic model in this study. The TAM is at present a preeminent theory of technology acceptance in Information System (IS) research. Numerous empirical tests have shown that TAM is a robust model of technology

acceptance behaviors in a wide variety of IT (for a literature review, see [LeIC03] [VMD+03]). Even though TAM was applied to study work-related activity, the theory is applicable and has been successfully applied to diverse non-organizational settings including several fields of mobile commerce (e.g., [Paga06]).

According to the TAM, *perceived usefulness (PU)* is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" and *perceived ease of use (PEOU)* is defined as "the degree to which a person believes that using a particular system would be free of effort" [Davis89, p. 320]. Both constructs influence one's attitude toward system usage, which influences one's behavioral intention to use *(intended use, IU)* a system, which, in turn, determines actual system usage. After refinement, attitude toward usage was eliminated from the model [DaBW89].

Some studies already underlined the importance of the criteria perceived usefulness and perceived ease of use for mobile payment acceptance (e.g., [DaMa02] [DaMÖ03] [Pous03]). As in previous studies using TAM, the underlying logic is that IT users react rationally when they elect to use an IT. The more useful and easy to use is the mobile payment procedure, the more will it be used. According to the classic TAM research [Davi89], perceived ease of use also has a direct effect on perceived usefulness, so our model reflects that.

H1: PU will positively affect IU of a mobile payment procedure.

H2: PEOU will positively affect IU of a mobile payment procedure.

H3: PEOU will positively affect PU of a mobile payment procedure.

2.2 Subjective Security

According to Kreyer, Pousttchi, and Turowski, we distinguish the concept security between the two dimensions objective and subjective security [KrPT02]. *Objective security* is a concrete technical characteristic, given, when a certain technological solution responds to all of five security objectives: confidentiality, authentication, integrity, authorization and non-repudiation (e.g., [Merz02]). As it is unlikely that the average consumer is able to evaluate the objective security of a procedure [EgAb01], a significant antecedent of mobile payment acceptance is the perception of security. We refer to *subjective security* as the degree to which a person believes that using a particular mobile payment procedure would be secure. Therefore, subjective security can be seen as the mirror image of risk affinity. It is important

to note that objective and subjective security are neither disjoint nor independent. Although subjective security has no effect on objective security, the level of objective security influences the level of subjective security.

Khodawandi, Pousttchi, and Wiedemann examined barriers to mobile payment adoption and indicated that the lack of subjective security is the most frequently called reason for a refusal [KhPW03]. Pousttchi stated infringement of subjective security would prevent consumers from using a particular procedure [Pous03]. Dahlberg, Mallat, and Öörni identified six different types of security risks and stated that these affect negatively the attitude towards using mobile payments [DaMÖ03]. Linck, Pousttchi, and Wiedemann developed a set of constructs which explains the nature of subjective security [LiPW06]. In this paper, we refine some of these results and propose two constructs which may affect perceived usefulness and intended use.

Perceived confidentiality (PC). According to Merz, confidentiality is the property of an information system that ensures that transaction information cannot be viewed by unauthorized persons [Merz02]. Typically, encryption is used to ensure confidentiality. We refer to *perceived confidentiality* as the degree to which a person believes that that the collection and subsequent access, use and disclosure of his or her personal data and payment details is consistent with his or her expectations. According to Pousttchi, confidentiality of data proved by far to be the most important acceptance criteria for mobile payment. Customers care about how a mobile payment procedure is protected against passive monitoring of payment details. [Pous03] Therefore, when consumers believe that their payment details are kept in confidence, this becomes an enabling factor for them to use the procedure. On the other hand, when such concerns stop consumers from using the mobile payment procedure, the procedure itself becomes less useful to the consumers.

H4: PC will positively affect IU of a mobile payment procedure.

H5: PC will positively affect PU of a mobile payment procedure.

Perceived trustworthiness (PT). Generally, consumer trust in a company is an important determinant of the consumer's actions regarding that company (e.g., [GeKS03]). The definition and operationalization of trust has been a source of considerable debate. Very often, trust has been defined as a belief regarding the characteristics of the company to be trusted (for a review, see [GeKS03]).. The characteristics usually include the company's integrity,

benevolence and competence [MaDS95], all of which comprise the company's trustworthiness, as perceived by the consumer. For the purposes of this study, the term perceived trustworthiness is used to represent consumer trust in the mobile payment service provider. The Theory of Planned Behavior [Ajze91] has shown beliefs to be important predictors of an individual's intentions and subsequent actions. Therefore, a consumer's perceptions of the mobile payment service provider's trustworthiness, a belief in its benevolence, integrity, and ability, should also affect consumer intentions to use a mobile payment procedure.

H6: PT will positively affect IU of a mobile payment procedure.

Although perceived confidentiality and perceived trustworthiness can be meaningfully distinguished as two separate theoretical constructs, they are expected to influence one another [HaKo05]. When a mobile payment service provider offers technologies like encryption techniques in order to prevent unauthorized access, consumers may perceive the procedure as secure. This may increase their trust in the mobile payment service provider itself. In other words, a consumer is likely to use a mobile payment procedure that is perceived as secure, and at the same time, he or she is likely to use a procedure that is offered by a trustworthiness provider[1].

H7: There is a positive correlation between PC and PT.

2.3 Task-Technology-Fit

In the context of mobile payment, a use case is defined as a 3-tuple of a payment scenario, a payment amount, and a description of an everyday life situation [LiPW06]. In this study, we look at use cases in the same way as scholars have done with respect to the task that the technology is intended to support. The Task-Technology Fit (TTF) model [GoTh95] proposes characteristics of technology, tasks, and individuals as explanatory variables for technology use and individual performance. TTF is viewed as the extent to which technology functionality matches task requirements and individual abilities. According to Dishaw and Strong, who combined TAM and TTF model to provide a better explanation of information

[1] Our survey included also questions whether and why the mobile payment service provider has to be a bank, since two prior studies had indicated that banks are perceived as outstanding trustful mobile payment services providers [KhPW03] [EiLP04]. The respective results will be presented in future papers.

technology utilization, TTF determines the TAM's determinants of attitude toward IT, namely perceived usefulness [DiSt99]. In their study, the correlation between TTF and perceived usefulness was low and not significant, however, from a theoretical view, this is expected to be a strong association; good fit between the functionality of the technology and the characteristics of the task should be interpreted by a consumer as high perceived usefulness of the technology for that task. In the context of mobile payment, that is, if a mobile payment procedure provides a good fit with the respective use case, consumers should perceive that the procedure is useful.

H8: Use cases with higher TTF will result in higher PU of a mobile payment procedure.

3 Method

This study used an online survey conducted between February and September 2006. Participants were recruited by advertising on a number of German websites and newsletters. There was no incentive for participation except a summary of the results.

The research design was a combination of a correlation design and an experiment. While the hypotheses regarding the other constructs were tested with an online survey instrument, the hypotheses regarding the TTF construct were tested with an experimental treatment.

One advantage of using the TAM to examine mobile payment acceptance is that it has a well-validated measurement inventory. The constructs perceived ease of use, perceived usefulness, and intended use were measured using scales adapted from Davis [Davi89] and modified to fit the specific technology studied.

The constructs perceived confidentiality and perceived trustworthiness were measured by items specially developed for this study using a step-by-step process according to Edwards [Edwa57]. The findings presented in [LiPW06] were used to generate all in all 31 items. To select the final items we used a pretest with 57 students, analyzed item-total correlation of these data, and eliminated all items with the total score less than 0.7. In so doing, 5 items retained for the construct perceived confidentiality. All items were measured with a seven-point Likert scale (1 = "strongly agree" and 7 = "strongly disagree"). The questionnaire is provided in the Annex.

TTF was measured using two scenarios representing hypothetical use cases. We first introduced a specific mobile payment procedure to the participants with screen shots, and then presented a randomly selected use case in which the procedure could be used. One scenario represents a situation with low TTF, and the other a situation with high TTF. The first treatment, mobile payments at a super market cash desk, was developed to present a situation where mobile payments have several competing payment methods and the payment has to be quick and error-free in order to avoid comments of other queuing people. A mobile payment procedure was expected not to fit this task. The second treatment, mobile payments at a parking ticket machine, was developed to present a situation where mobile payments competes typically only against cash and a cashless payment procedure. Mobile payments would solve the consumer's problem of having small coins. A mobile payment procedure was expected to fit this task. Also relative low and high use case assessments of consumers presented in [EiLP04] confirmed the choice of both scenarios. After representing the scenarios, participants were then asked to answer the rest of the online questionnaire. To keep the scenario in mind of participants the respective scenario was represented by a photo during the questionnaire.

4 Results

Sample

We checked plausibility, integrity and completeness of the 1,632 received questionnaires with the result that 1,104 could be used for further analysis. The sample of German mobile phone users (Table 1) consisted of 75.63 per cent males and 24.37 per cent females. Respondents' direct statements let the sample appear as the target group for MP: 20.38 % indicated that they have already used a mobile payment procedure. Since completing the questionnaire took about 20 minutes, we can also assume that it was necessary for most of the respondents to have a certain interest in mobile payment. Further, when talking to mobile payment service providers about their target group we see remarkable similarities to the sample. Our conclusion is that we cannot make general statements about the total population but very well of the current mobile payment target group.

Characteristics	N	per cent
Age		
≤ 21	137	12.41
22 - 30	467	42.30
31 - 40	285	25.82
41 - 50	134	12.14
> 50	81	7.34
Highest educational level completed		
Have not completed secondary general school	2	0.18
Secondary general school (Hauptschule)	26	2.36
Intermediate school (Realschule)	105	9.51
High school (Gymnasium)	417	37.77
University or university of applied sciences	520	47.10
Other	17	1.54
Missing	17	1.54
Occupation		
Pupil	55	4.98
Trainee	21	1.90
Student	368	33.33
Employee	437	40.94
Civil servant	37	3.35
Self-employed	121	10.96
Jobless person	14	1.27
Others	36	3.26
Missing	--	--

Table 1. Demographic characteristics of participants (N = 1,104).

Reliability and validity of constructs

Table 2 shows the reliability of the measurement scales. All resulting scales are sufficiently reliable. It should be noted that the reliability of perceived usefulness is relatively weak. Further data analysis demonstrated that it could be improved by pruning the fourth item; however, this was not pursued for the sake of scale integrity.

Construct	Number of items	Cronbach's α
IU	2	0.894
PU	4	0.632
PEOU	5	0.882
PC	5	0.862
PT	3	0.691

Table 2. Reliability coefficients for each construct.

Using principle factor analysis to examine the convergent and discriminant validity of the five multi-item constructs has not turned out satisfactory. Thus, we used an exploratory factor

analysis of all items except for the items of intention to use. Table 3 presents the factor loadings and the communalities for each item extracted after 6 rotations. The factors accounted for 68.4 per cent of the total variance. There were no cross construct loadings above 0.50 showing good discriminant validity. All factor loadings were 0.5 or above showing good convergent validity. These constructs are therefore unidimensional and factorially distinct. As the items for intention to use were excluded (factor loadings on one factor were 0.848 and above), multicollinearity was considered with the application of the multiple regression analysis.

Item	Factor loading				Communality
	1	2	3	4	
PU1	.817				.649
PU2	.813				.720
PU3	.763				.678
PU4	.744				.598
PEOU1		.863			.798
PEOU2		.817			.715
PEOU3		.814			.780
PEOU4		.746			.645
PEOU5		.593			.604
PC1			.845		.733
PC2			.809		.689
PC3			.745		.632
PC4			.701		.647
PC5			.683		.674
PT1				.832	.810
PT2				.804	.770
PT3				.604	.449

Table 3. Summary of items and factor loadings for varimax orthogonal four-factor solution.

Descriptive

Table 4 presents an overview of the means, standard deviations and product moment correlations of the five constructs.

	M	SD	IU	PU	PEOU	PC	PT
IU	3.10	1.58	1				
PU	3.27	1.47	.815(**)	1			
PEOU	2.20	1.09	.521(**)	.570(**)	1		
PC	1.36	.75	-.009	.017	.234(**)	1	
PT	1.62	.86	-.005	.030	.165(**)	.61(**)	1

Table 4. Means, standard deviations, and product moment correlations of the constructs (N = 1104). Note: ** p < .01.

There is a significant positive correlation between the two constructs of perceived confidentiality and perceived trustworthiness (r = .61). Hypothesis H7 is therefore supported.

Multiple regression analysis was used for testing the hypotheses H1, H2, H4, and H6 (Table 5) and H3 and H4 (Table 6). Multicollinearity was not a concern with this data set as variance inflation factors (VIF) range from 1.058 to 1.661.

Hypothesis	Variable	B	SEB	Beta	t	p	Supported
1	PU	.815	.023	.760	35,620	.000	YES
2	PEOU	.142	.032	.098	4,480	.000	YES
4	PC	-.060	.047	-.029	-1,286	.199	NO
6	PT	-.050	.040	-.027	-1,243	.214	NO

Table 5. Regression analysis summary for variables predicting intention to use mobile payment. R^2 is 67.1 per cent, F = 558.08, p < 0.001.

Hypothesis	Variable	B	SEB	Beta	t	p	Supported
3	PEOU	.805	.034	.599	23.788	.000	YES
5	PC	-.241	.049	-.124	-4.903	.000	NO

Table 6. Regression analysis summary for variables predicting perceived usefulness. R^2 is 34.0 per cent, F = 283.16, p < .001.

The summary shows that the hypotheses of the classical TAM are supported whereas the hypotheses regarding perceived confidentiality and perceived trustworthiness are rejected.

T-test for equality of means was used for testing the hypothesis H8 (Table 7). 707 (64.04 per cent) participants assessed the super market scenario (M=3.33; SD=1.51; SEM=.06) and 397 (35.96 per cent) assessed the parking scenario (M=3.17; SD=1.39; SEM= .70).

		Levene's -Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PU	Equal Variance Assumed	4.870	0.028	-1.713	1102	0.087	-0.15788	0.09218	-0.33876	0.02300
	Equal Variance not Assumed			**-1.755**	**881**	**0.080**	**-0.15788**	**0.08995**	**-0.33442**	**0.01866**

Table 7. Independent sample test.

As the hypothesis is 1-tailed formulated, there is a significant relationship between TTF and perceived usefulness (p=0.04). Thus, hypothesis H8 is supported.

5 Discussion and Implications

The primary objective of this study was to examine consumer acceptance of mobile payment in Germany in the light of the TAM added with new variables derived from prior research [LiPW06] and the TTF model [GoTh95].

With this study we have shown that a perceived confidentiality of payment details and perceived trustworthiness of a mobile payment service provider are strongly correlated. Further, perceived usefulness and perceived ease of use had a significant impact on intentions to use a mobile payment procedure. However, we could not find evidence for the impact of the analyzed constructs regarding subjective security. There was a significant positive influence of perceived ease of use on perceived usefulness, implying that those who consider mobile payment to be easy to use also perceive it to be more useful. The hypothesis regarding perceived confidentiality and perceived usefulness could not be supported. Finally, a better TTF caused a significant change in perceived usefulness, implying that people find mobile payments in more relevant contexts more useful than in less relevant contexts.

From a theoretical standpoint, the results contribute to the existing literature in a number of ways. First, the paper makes a contribution to mobile payment literature by providing insights on the drivers of mobile payment acceptance. The results hint that an easy mobile payment process and its benefits are the critical acceptance criteria. Second, the findings indicate that perceived confidentiality and perceived trustworthiness had no influence on intention to use and perceived confidentiality had no influence on perceived usefulness. This is in contrary to

many mobile payment studies conducted during the past years (e.g., [EiLP04] [DaMÖ03]) and not consistent with the results reported in the electronic commerce literature (e.g., [GeKS03]). From a theoretical view, these relationships were expected to be strong associations; higher subjective security should be interpreted by a consumer as high perceived usefulness and should also influence his or her intention to use. Further research is necessary to clarify this issue. Third, the paper contributes to the technology acceptance literature by suggesting that TTF was found to have some effect on perceived usefulness supporting the respective (and not supported) hypothesis of Dishaw and Strong [DiSt99]. Finally, the finding regarding the use cases suggests that fit between the use case and the business-to-consumer application mobile payment operates in the same way as fit between task and technology in work-related activities.

From a practical standpoint, the findings indicate that the implementation of security feature like encryption techniques have a direct effect on the perceived trustworthiness of the mobile payment service provider. These provide him with evidence where he has to start the efforts to achieve a security feeling for customers. Further on, the findings confirm consumers' requirement of a convenient and easy to use procedure and link this to perceived usefulness and intended use.

Although the results can be considered statistically significant in most parts, the study has several limitations that affect the reliability and validity of the findings. The first limitation of this study lies in its specific focus on two particular use cases. Moreover, we differentiated not between micropayments and macropayments in our analysis. It would be interesting to see how TTF is perceived in other use cases in order to find appropriate market entry use cases for mobile payment service providers. Further, as macropayments require a better fulfillment of consumer security requirements, a differentiation between payment amounts would be desirable. Future research is recommended in these areas. Although the sample size was quite large compared to sample sizes of other TAM studies, it consisted of German Internet users only. Since it is impossible to control who actually responds to an online survey, the sample in this study may result in an inherent bias as people with certain characteristics or backgrounds may be more likely to respond. Especially, the results regarding subjective security may caused by the sample consisting of many male and young participants as well as students who a more willing to take a risk. Thus, a replication of the study in other markets would be eligible. The third limitation of this work concerns the measures for user acceptance. According to Legris et al., perceived usefulness and perceived ease of use are not

the only predictors of technology acceptance [LeIC03]. The classic TAM has been extended for example by Venkatesh and Davis who introduced the second version of TAM to explain how subjective norms and cognitive instrumental processes affect perceived usefulness and intentions [VaDa00]. Venkatesh et al. compared eight models and formulated the Unified Theory of Acceptance and Use of Technology (UTAUT). The theory holds that four key constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions) are direct determinants of usage intention and behavior. Gender, age, experience, and voluntariness of use are posited to mediate the impact of the four key constructs. [VMD+03] On this basis, our model might also suffer from the fact that other possible factors influencing the acceptance of mobile payment were not included in the model. These limitations pave the way to future studies. Furthermore, another interesting avenue for further research could be a detailed study on acceptance of mobile payment in view of merchants.

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Appendix

Item	Measurement
IU1	Assuming I could use a mobile payment procedure at a merchant, I intend to use it.
IU2	Given that I could use a mobile payment procedure, I predict that I would use it.
PU1	Using mobile payment would enable me to pay more quickly.
PU2	Using mobile payment make it easier for me to conduct transactions.
PU3	I would find mobile payment a useful possibility for paying.
PU4	Using mobile payment enable me to set small coins aside.
PEOU1	I would mobile payment easy to use.
PEOU2	Learning to mobile pay would easy for me.
PEOU3	I would find mobile payment easy to use.
PEOU4	My interaction with a mobile payment procedure would be clear and understandable.
PEOU5	I would find a mobile payment procedure to be flexible to interact with.
PC1	Data transfer must be encrypted.
PC2	The mobile payment procedure has to use an accredited data encryption technique.
PC3	The transfer of payment data transfer has to be encrypted.
PC4	The handling of my personal data must be discreet.
PC5	Payment data must be secured against unauthorized access.
PT1	The mobile payment service provider must be trustworthy.
PT2	The mobile payment service must give a reliable impression to me.
PT3	The mobile payment service provider proved by an independent institution.

Table 8. Items used in the online survey.