

Wireless Mobile Collaboration

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The focus of this new mini-track is on the rapidly changing and evolving use of wireless mobile computing technologies for human-to-human and human-to-machine collaboration. This mini-track is intended to provide a forum for reporting the results of research focusing on system and application development and technology usage as well as the reporting of user adoption, deployment, acceptance, and diffusion among academicians and practitioners in the computer-based system sciences. As such, the wireless mobile collaboration mini-track focuses on the conceptual design, implementation, use, and evaluation of wireless mobile computing technologies in controlled, organizational and broader societal settings.

We include four papers to be presented as part of this new mini-track on mobile wireless collaboration. The first paper is by Khalifa and Cheng and is titled, "Adoption of Mobile Commerce: Role of Exposure. In this paper the authors develop and empirically test a model for explaining the role of exposure to mobile technology in the adoption of mobile commerce. The results show exposure has both indirect and moderating effects on the intention of adopting mobile commerce. The second paper is by Urbaczewski, Wells, Koivisto, and Sarker, and is titled, "Cultural Differences in Creating the Global Mobile Internet: A Theoretical Basis and Program of Research." In that paper the authors discuss mobile e-commerce and the role that culture plays in its globalization. They then pose a series of interesting research questions, existing theories suitable for studying these questions, and a proposed program of related research. The third paper is by Marsic, Krebs, Dorohonceanu, and Tremaine, and is titled, "Designing and Examining PC to Palm Collaboration." In this paper the authors describe an architecture for managing displays across multiple mobile computing platforms. They then operationalize this architecture in a collaboration system and experiment with its use across different platforms, with interesting results. The fourth paper is by Okoli, Ives, Jessup, and Valacich, and is titled, "The Mobile

Conference Information System: Unleashing Academic Conferences with Wireless Mobile Computing." In this paper the authors provide a vision for how a mobile, wireless platform could be used to support and extend academic conferences. Perhaps one day soon we will see HICSS or some other such conference run in this way. In any event, we hope you enjoy these papers and that they prompt you to consider conducting research in this new and exciting area.

Adoption of Mobile Commerce: Role of Exposure

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Abstract

The increasingly high penetration rate of mobile phones and the consequent exposure of subscribers to mobile technology present high hopes for the adoption of mobile commerce. Are such hopes justified? In this study, we address this question. More specifically, we develop and empirically test a model for explaining the role of exposure to mobile technology in the adoption of mobile commerce. The proposed model extends well-established behavioral theories with new constructs representing various forms of exposure, i.e., trial, communication and observation. The empirical results show significant both indirect (mediated by other constructs) and moderating effects of exposure on the intention of adopting mobile commerce.

Introduction

Mobile commerce is expected to be the next big wave of business. A number of mobile commerce applications have been developed and are already in use, covering a wide range of business functions from advertising, to banking. Given the already high mobile phone penetration (a penetration rate of over 60% in Europe and over 40% in the USA according to most sources), the rapid growth of mobile commerce seems assured. The high penetration rate of mobile phones facilitates the exposure to mobile technology. Individuals are more likely to try, discuss or observe the usage of mobile technology for commerce. It is not clear, however, whether such exposure will affect mobile commerce adoption. In this research, we address this issue through the development and empirical validation of a model explaining the adoption of mobile commerce that takes into account the role of exposure.

Several behavioral models for explaining/predicting the adoption and usage of information technology have been proposed in the IS literature. These models include the Theory of Reasoned Action [16], Triandis' model [22], the Technology Acceptance Model [13], the Theory of Planned Behavior [2], and the Decomposed Theory of Planned Behavior [21]. In all of these models, the beliefs

and attitude of the individual towards a certain behavior are important determinants of the individual's intention towards the adoption of that behavior, e.g., using mobile commerce. Most of the IS studies that empirically tested these models relied on surveys of individuals' perceptions and did not account for the certainty and clarity of these perceptions. Depending on the level of exposure of the individual to the behavior under study, the attitudinal qualities (e.g., certainty and clarity) of an individual and his/her perceived behavior control can vary considerably. While perceived behavior control affects adoption intentions directly, attitudinal qualities affect the attitude-behavior consistency [15].

In this research, we investigate the effects of the exposure of an individual to mobile commerce on the individual's intention to adopt it. This is done based on the TPB framework. The resulting theoretical model represents an important extension of the TPB with new constructs such as "trial", "observation", "communication", "exposure" and several new links. The model is tested empirically through a survey administered to mobile phone users who have not engaged in mobile commerce yet. In addition to its theoretical contributions, this study presents important practical contributions. In particular, practitioners will gain valuable insights on the role of exposure under its different forms, i.e., trial, observation and communication, in the adoption and usage of mobile commerce.

The paper proceeds as follows. In the next section, we present our research model and its theoretical foundation. This is followed by a description of an empirical study designed to test the proposed model. We then discuss the empirical results and their implications.

Theoretical Development and Research Model

Most of the IS studies on adoption and usage of information technology relied on models derived from the Theory of Reasoned Action (TRA) and its extensions. The TRA [16] stipulates that human behavior is preceded by intentions, which are formed based the individual's attitude towards the behavior and subjective norms. Attitude reflects the individual's feelings of favorableness or unfavorableness towards performing a behavior.

Subjective norms reflect perceptions that significant referents (e.g., family, peers, authority figures, media) desire the individual to perform or not perform a behavior. Ajzen [2] developed further the TRA into the Theory of Planned Behavior (TPB) by adding a new construct "perceived behavioral control" as a determinant of both intention and behavior. Perceived behavioral control reflects perceptions of internal constraints (self-efficacy) as well as external constraints on behavior.

The TPB has been applied extensively in the context of information technology adoption. Most previous research focused on adoption intention and hence involved surveys of individuals who may have never been exposed to the technology under consideration. To our knowledge, none of the previous studies accounted for the individual's level of exposure to the technology. In this research, we define exposure as the degree to which an individual has acquired or exchanged information about the technology and its usage. Exposure can take several forms, namely observation, communication and trial. The exposure to a new technology depends on important characteristics of the technology, which can affect the technology's diffusion. Observation, for instance, depends on the "observability" of the technology. Rogers [20] defines "observability" as the degree to which the result brought by the technology and the technology itself can be visible. Similarly, trial depends on "triability", which is defined by Rogers as the degree to which a technology can be experimented with before adoption. As illustrated in Figure 1, our research model stipulates that exposure is mainly determined by trial, observation and communication.

H₁: The individual's trial of mobile commerce has a positive effect on his/her level of exposure to mobile commerce. The more extensive the trial, the higher is the exposure.

The first hypothesis refers to the role of trial in enhancing the individual's exposure. Several mobile service carriers set up booths or Internetbased simulators for potential customers to try out mobile commerce applications such as checking stock prices and ticketing. Through trial, the individual acquires information about the capabilities, usability and limitations of mobile commerce. The extent to which the individual experiments with mobile commerce affects positively the level of his/her exposure.

H₂: The individual's communication with others regarding mobile commerce has a positive effect on his/her level of exposure to mobile commerce. The more extensive the communication, the higher is the exposure.

Verbal or/and written communication with others regarding mobile commerce enables the individual to acquire new information and to crystallize his/her perceptions of mobile commerce. Vendors of mobile technology are enabling this source of exposure through chat rooms and discussion forums.

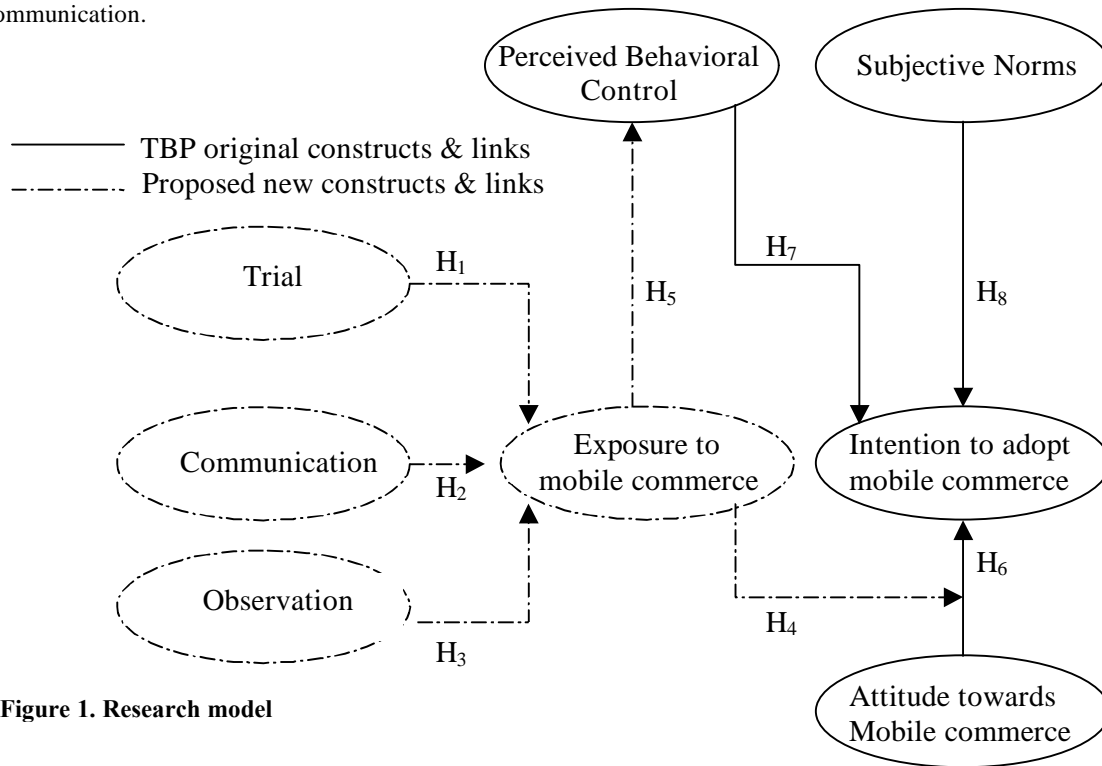


Figure 1. Research model

H₃: The individual's observation of others conducting mobile commerce has a positive effect on his/her level of exposure to mobile commerce. The more extensive the observation, the higher is the exposure.

Observation may be the most common source of exposure. Advertisers often promote their products by showing people using their products and having positive results. While with communication and trial the individual is active, with observation the individual is passively receiving information.

While hypotheses H₁₋₃ are related to the determinants of exposure, hypotheses H₄ and H₅ define the effect of exposure on the intention to adopt mobile commerce. The effect of exposure on behavior is not a direct one. Exposure affects behavior intention through perceived behavioral control and through the moderation of the link between attitude and intention.

H₄: Exposure to mobile commerce moderates positively the relationship between attitude and intention. The higher the exposure the stronger is the relationship between attitude and intention.

Information acquired through exposure can account for potential attitude-behavior inconsistency [12]. Individuals who are not familiar with mobile commerce may form attitudes based on very little information. Such attitudes are usually not clear enough or strong enough to translate into adoption intention and later into usage of mobile commerce. In other words, exposure moderates the effect of attitude on intention by affecting the attitudinal qualities. The social psychology literature covered extensively attitudinal qualities and their role in attitude-behavior inconsistency. Krosnick et al. [18] reviewed the literature and identified several attitudinal qualities such as extremity, intensity, certainty, accessibility, clarity or latitude of rejection and affective-cognitive consistency. Exposure moderates the relationship between attitude and intention by directly affecting attitudinal qualities such as certainty and clarity. Higher exposure provides the individual with more information that strengthens his/her attitude and makes it clearer. This in turn strengthens the relationship between attitude and intention enhancing in this way the attitude-behavior consistency ([6]; [15]; [17]). Similar arguments were also used in the marketing literature, (e.g., [1]; [5]).

H₅: Exposure to mobile commerce affects positively the individual's perceived behavioral control. The higher the exposure the higher is the perceived behavioral control.

Through exposure, the individual acquires information that can improve his/her self-efficacy enhancing in this way his/her perceived behavioral control. Self-efficacy is

an important component of perceived behavioral control [21] and refers to an individual's belief in his/her capability to perform a certain behavior [4]. Self-efficacy develops from multiple sources of information that include in particular vicarious experience and verbal persuasion [3]. Exposure through observing others perform a certain behavior allows and individual to gain more confidence in his/her ability to perform the behavior. Through extensive observation, a learning process takes place, i.e., vicarious experience [14]. Also, exposure through communication may include encouragement from others that would bolster the individual's belief that he/she can perform the behavior.

The remaining hypotheses (H₆₋₈) refer to relationships between intention and its immediate antecedents, i.e., attitude, perceived behavioral control and subjective norms, as stipulated in the TPB (discussed earlier).

Methodology

To test the research model, we conducted a cross-sectional survey study. A questionnaire was developed, pre-tested and then administered to mainly part-time students who had full-time jobs. Over 50% of the students had at least one graduate degree (e.g., MBA) and were enrolled in a second (and sometimes third) degree, i.e., a master's program in electronic business. On average, the students had over 10 years of work experience. Out of 220 distributed questionnaires 202 were returned. Giving gift coupons to the respondents helped obtain this high response rate (over 91%). All targeted participants had mobile phones but had not adopted yet mobile. The demographic profile of the respondents is described in Table 1.

Table 1. Demographic profile of respondents

Mobile phone	WAP Enabled	22.8%
	Without WAP	77.2%
Gender of the Respondents	Male	53.5%
	Female	46.5%
Age of the Respondents	18-22	48%
	23-27	5.4%
	28-32	10.4%
	33-37	19.3%
	38-42	12.4%
	43-47	1.0%
Educational Background	Undergraduate	49.5%
	Graduate	50.5%
Years of Experience with the Internet	0-2 Years	24.8%
	3-4 Years	48%
	5-6 Years	19.8%
	7-8 Years	5.5%
	9-10 Years	1.5%
Number of Friends using WAP for mobile commerce	None	49.5%
	1-5	41.1%
	6-10	5.4%
	11-20	1.0%
	>20	2.0%

Measures

In order to ensure measurement reliability in the operationalization of the constructs, we tried to choose those items that had been validated in previous research. All constructs were measured with reflective items. The scales for the TPB constructs, i.e., subjective norms, perceived behavioral control, attitude and intention were adapted from the scales used by Taylor and Todd [21]. We developed the remaining scales according to Churchill's [9] paradigm. In order to ensure face and discriminant validity of the measurement scales we used the card sorting procedure proposed by Moore & Benbasat [19]. We then pre-tested the questionnaire with 40 students. After examination of the Cronbach's alphas and correlation matrices, we realized that no changes were required. We ended up with 18 items for the eight constructs.

Data Analysis

The analysis of the data was done using Partial Least Square (PLS), which is a procedure that enables the specification of both the relationships among the constructs and the measures underlying each construct Wold [24]. The PLS analysis indicates how well the measures relate to each construct and whether the hypothesized relationship at the theoretical level are empirically true. PLS-Graph [7] was used to perform the analysis. In evaluating the measurement model, path loadings of 0.7 or higher were considered as acceptable. For the evaluation of the structural model (hypothesized links) the bootstrap resampling procedure [11] was applied to test the significance of the paths coefficients. In assessing the internal consistency, we looked at the composite reliability measures (ρ) developed by Werts et al. [23]. In formulating and testing the moderating effect of exposure on the relationship between attitude and intention, we applied the procedure described by Chin et al. [8]. More specifically, we followed a hierarchical process similar to multiple regressions where we compared the results of two models (i.e., one with and one without the interaction construct: exposure x attitude). The standardized path estimate from the product construct (exposure x attitude) to intention indicates how a change in the degree of the moderator construct (exposure) would change the influence of attitude on the dependent construct (intention). Thus, if attitude has an estimated beta effect of B on intention, a beta of M for the interaction path can be interpreted as a beta change of B+M for the estimated path from attitude to intention when exposure increases by one standard deviation from the baseline of zero. By comparing the R-square for the interaction model with the R-square for the main effect model (which excludes the interaction construct), we can assess the strength of the moderating effect. The significance of the difference in R-

squares is estimated with $(f^2)^1$ where f^2 scores of 0.03, 0.15 and 0.35 suggest small, moderate, and large interaction effects respectively [10]. It is important to understand that a small f^2 does not necessarily imply an unimportant effect. If there is a likelihood of occurrence for the extreme moderating conditions and the resulting beta changes are meaningful, then it is important to take these situations into account.

Results and Discussion

The results of the PLS analysis are presented in Table 2 and Figure 2. The estimated path coefficient (standardized) and its associated t-value are specified next to each link in Figure 2. The R^2 statistic is indicated next to each dependent construct. Table 1 presents the loading, standard error and t-statistic of the items to their respective constructs. For all constructs, most of the items had reasonably high loadings (i.e. above 0.70) with the majority over 0.80, therefore demonstrating convergent validity (see Table 1). Very few items had loadings below 0.70 and these were complemented by other more reliable measures. Furthermore, all items were found to be significant (almost all at the 0.01 level). The composite reliability measures (see ρ in Table 2) provided additional support for reliability and convergent validity.

Trial, communication and observation explained 67% of the variance in exposure. The effects of trial and communication on exposure were found to be significant at the 1% level, verifying hence hypotheses H_1 and H_2 . Trial had the strongest effect with a path coefficient of 0.62. Communication had a weaker effect with a path coefficient of 0.2. The effect of observation on exposure, on the other hand, was not found to be significant and hence hypothesis H_3 could not be verified. These empirical results suggest that trial and communication represent important sources of exposure (with R^2 exceeding 67%). The lack of significance of the effect of observation may be explained by the fact that observation is passive. While with trial and communication, the individual interacts with the object of interest and with other individuals; with observation the individual is passively receiving information. The interactive approach seems to be a more effective source of exposure. Marketers of mobile commerce technology should therefore encourage potential adopters to try out the technology and discuss it with support staff and other adopters. These methods have better effects on the individual's exposure than observation methods such as mass advertising.

¹ $f^2 = [R^2(\text{interaction model}) - R^2(\text{main effects model})] / [1 - R^2(\text{main effects model})]$

Table 2: Loadings, significance & composite reliability (r)

Construct	Measurement Item	Loading	Standard Error	t-Statistic
Intention $\rho = 0.9414$	I1	0.8898	0.0162	54.9076
	I2	0.9407	0.0093	101.6024
	I3	0.9229	0.0143	64.7471
Attitude $\rho = 0.9565$	A1	0.9293	0.0163	57.1419
	A2	0.9583	0.0085	112.1449
	A3	0.9264	0.0181	51.1530
Exposure $\rho = 0.9140$	E1	0.9079	0.0187	48.5425
	E2	0.9269	0.0104	89.3765
Trial $\rho = 0.8448$	T1	0.5598	0.0739	7.5779
	T2	0.9071	0.0170	53.4563
	T3	0.9093	0.0134	68.1071
Communication $\rho = 0.8610$	C1	0.8107	0.0404	20.0449
	C2	0.8279	0.0358	23.1111
	C3	0.8236	0.0245	33.6464
Observation $\rho = 0.8850$	O1	0.7167	0.0498	14.4019
	O2	0.9208	0.0135	68.2357
	O3	0.8965	0.0175	51.1073
Subjective Norms $\rho = 0.8798$	S1	0.7841	0.0345	22.7265
	S2	0.8643	0.0249	34.7735
	S3	0.8759	0.0178	49.0993
Perceived Behavioral Control $\rho = 0.8655$	P1	0.8339	0.0313	26.6106
	P2	0.8322	0.0345	24.1168
	P3	0.8113	0.0490	16.5406

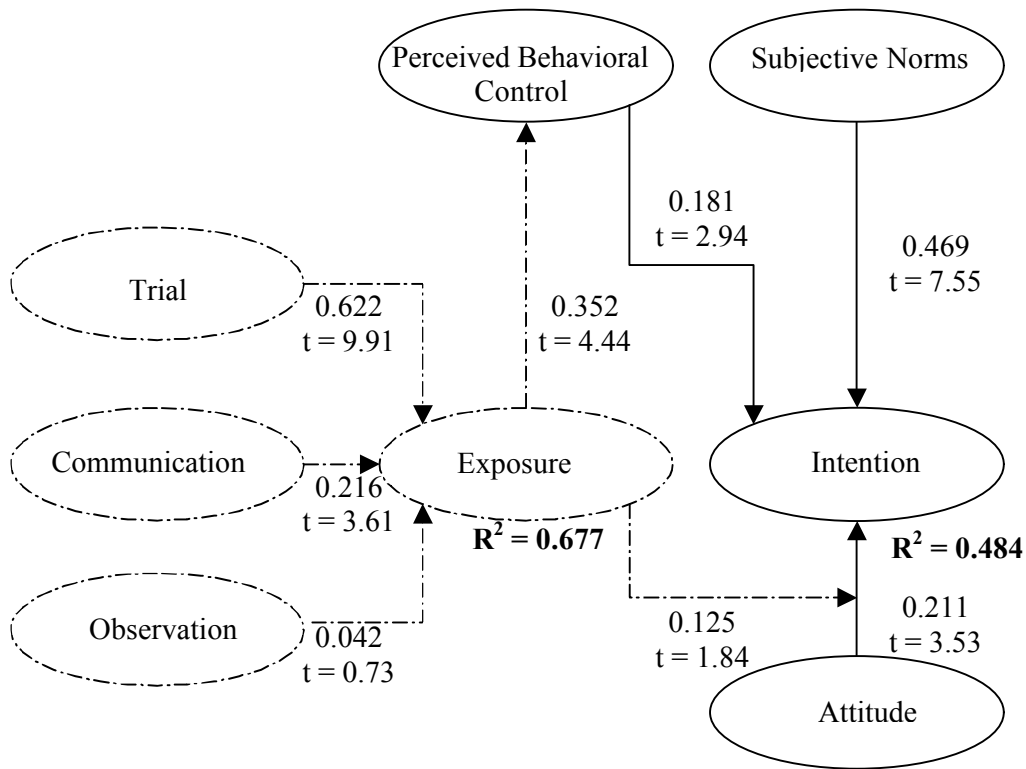


Figure 2: Result of PLS analysis

The empirical results support the hypothesized role of exposure in intention formation. Both hypotheses H_4 and H_5 were verified. The moderating effect of exposure was found to be significant at the 5% level with a path coefficient of 0.12. The interaction effect has an effect size f^2 of 0.03, which represents a solid small effect. The effect of exposure on perceived behavioral control was found to be significant at the 1% level with a path coefficient of 0.35. We also tested for a possible direct link between exposure and intention, but we did not find it to be significant. The results indicate that the effects of exposure on intention are not direct but rather mediated or moderating. With the moderating effect, exposure strengthens the relationship between attitude and intention. Individuals who are more familiar with mobile commerce are more likely to translate favorable attitudes into intentions to adopt mobile commerce. The significant moderating effect of exposure on the link between attitude and intention may explain why some studies did not find this link to be significant. These studies might have involved subject that were not familiar with the technology under consideration and hence these subjects did not have attitudes that were strong enough to affect the subjects' intentions significantly.

With the mediated effect, exposure influences intention formation through perceived behavioral control. The exposure of an individual to mobile commerce enhances his/her belief in his/her capability to engage in mobile commerce, which in turn influences positively the individual's intention to adopt mobile commerce. This emphasizes the educational role of exposure. Exposure that boosts the individual's self-confidence in using the technology is more likely to have a significant effect on intention.

The hypotheses associated with the TPB ($H_{6,8}$) were also verified, providing yet another supportive case for the suitability of the TPB. Subjective norms have the strongest effect on intention with a path coefficient of 0.46. This highlights the importance of social influence in the adoption of mobile commerce. The media in particular could play a key role in this regard. The effect of attitude and perceived behavioral control are weaker with path coefficients of 0.21 and 0.18 respectively. Nonetheless these effects are significant at the 1% level.

Conclusion

In this research we investigated the role of exposure in intention formation within the context of mobile commerce adoption. More specifically, we developed and empirically tested a model that integrates exposure with its various sources, i.e. trial, observation and communication into the TPB framework. The study resulted in important theoretical and practical contribution. On the theoretical side, we gained a better understanding of the nature of the relationship between exposure and intention. We also

identified the major sources of exposure. The empirical results confirmed the hypothesized mediated and moderating effects of exposure. The verified moderating effect of exposure on the relationship between attitude and intention implies that favorable attitudes will not necessarily lead to adoption. The level of exposure of an individual to a certain technology will affect the qualities, e.g., certainty and clarity of his / her attitude towards that technology and consequently strengthens or weakens the effect of his/her attitude on his/her intention to adopt the technology. Therefore we should not always assume that attitude would have a significant effect on intention as stipulated in the TPB. The significance of such an effect depends on the level of the individual's exposure to the technology. The verified mediated effect, on the other hand, highlights the potential role of exposure in bolstering the individual's belief in his/her capability to use the technology. By enhancing the individual's perceived behavioral control, exposure affects intention formation indirectly.

On the practical side, a number of issues are worth mentioning. First, it seems that the high hopes for the diffusion of mobile commerce are not completely unfounded. With the high penetration of mobile phones and the aggressive marketing tactics of mobile carriers, exposure to mobile commerce technology is increasingly high. According to our results, such exposure is likely to facilitate the adoption of mobile commerce. In particular, interactive exposure, i.e., trial and communication with rich educational content seems to be the most effective. Finally, the magnitude of identified effect of subjective norms on intention highlights the importance of social influence in the adoption of mobile commerce. In particular, the media, as a source of social influence, can play an important role in the individual's intention formation. The media also contribute to exposure. This source of exposure i.e. observation, however, was not found to be as important as trial or communication.

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