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The role of psychological traits and social factors in using new mobile communication services

Kyung Kyu Kim, Ho Kyoung Shin *, Beomsoo Kim

Graduate School of Information, Yonsei University, Seoul, Republic of Korea

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ABSTRACT

A better understanding of users' decision making processes gives service providers greater insight to factors that guide users' adoption of new services and the development of future services. In this study, we assumed that key determinants of behavioral intentions to use mobile communication services including multimedia messaging services are the psychological traits of users and social factors. This research adhered to the social cognitive and social influence perspectives that are widely accepted theories of individual behavior to explore the multimedia messaging services usage behavior. An empirical investigation of current multimedia messaging services users in South Korea was conducted. The partial least squares analysis exhibited strong support for the role of credibility of the service, relative advantages, and perceived ease of use in shaping users' attitude and intention to use multimedia messaging services. This research accounted for the key forces of technological service characteristics and personal psychological traits affecting users' intention to adopt multimedia messaging services. This empirical analysis showed that the psychological traits of self-efficacy and peer influence are the most important factors to the formation of intention to use the new mobile service.

1. Introduction

Multimedia messaging services (MMS) are the next evolution in mobile services that will allow individual users to communicate using multimedia such as graphics, images, audio clips, and video clips, as well as text (Hsu et al., 2007; Lee et al., 2007). MMS has evolved from short message services (SMS), which already have a large user, base especially in Europe and Asia. With these more advanced services, information and entertainment, regardless of size and format, can be exchanged from mobile device to mobile device, among different devices (smart phones, digital cameras, computers), and among other services (microblogs, online community, social networking services). By overcoming the limits of communicating in simple text formats, MMS can expand mobile communications to social and business venues for human interactions. As mobile communication services advance, MMS have not only become a standard for mobile communication but also a social service to optimize group communication, advertising, target marketing, and business. Further, with the advancement of 3G and 4G network communication technologies, MMS have become essential applications for social communication. MMS have reshaped the landscape of mobile communication, making it more personal, more versatile, and more expressive than ever before (Hsu et al., 2007).

Despite all these promising capabilities of MMS, adoption is still in the early stage. Previous studies on the adoption of mobile communication services have mainly examined the technology diffusion process from the perspective of economic value (Turel et al., 2007). While economic value centered- research offers a basis for meaningful pricing strategy for new technology services, it does not explain what the key factors are related to individual intentions to use the new services, nor does it offer business policy implications targeting individual behavior. Not surprisingly, researchers have addressed the issues of adoption behavior for information communication technologies (ICT) from behavioral perspectives. Several theoretical models such as the technology acceptance model (TAM) (Davis, 1986, 1989) and the theory of planned behavior (TPB) (Ajzen, 1985, Ajzen and Madden, 1986) have appeared. There is some convergence among these models suggesting that an individual's beliefs about ICT have a significant influence on usage behavior (Agarwal and Karahanna, 2000).

Whereas previous research on ICT adoption has emphasized the notion of instrumentality, less emphasis has been placed on the user's cognitive complexity *as a member of social group*. Unlike other technologies (e.g., PC software for individual productivity enhancement), MMS should be considered as a *social phenomenon* as well as influential force on an individual behavior. When MMS users exchange multimedia messages with other people, the parties typically belong to the same social community such as social network sites (SNS) or are members of the same family with whom the

* Corresponding author. Tel.: +82 10 3940 1919; fax: +82 2 578 8543.
E-mail address: rosashin1@gmail.com (H.K. Shin).

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messages are shared. When members of a social group choose a particular behavior related to new technology, social factors play a significant role in the decision process. For example, the perceived usefulness of certain technology is significantly influenced by the extent to which salient others consider that technology as valuable (Fulk, 1993). Social cognitive theory (Bandura, 1977) and social influence theory are widely accepted and validated, and they explain the behavioral intention of using new technology or services for an individual *as a member of social group* (Compeau and Higgins, 1995). Agarwal and Karahanna (2000) assert that psychological traits are important antecedents of the social cognitive and social influential dimensions of technology adoption models. However, little effort has been made to include social dimensions in examining the user adoption behavior of mobile communication services (Walczuch et al., 2007). This paper attempts to fill the knowledge gap in understanding MMS adoption behavior by including social dimensions based on the social cognitive and social influence perspectives in addition to individual psychological theories. We speculate that social and psychological traits of MMS are antecedents to technology acceptance, and postulate the following research question: What are the key determinants that drive the adoption of MMS?

This study develops theoretical foundations that explain behavioral intention to use mobile communication services. An empirical investigation of MMS users in South Korea was conducted for this research. The paper is organized into four sections. The next section presents the theoretical foundation for this research. In the third section, the research model is described and the hypotheses are presented. An outline of the research methodology and the results of the analyses are also included in this section. The paper concludes with the implications of research findings and the limitations of this research.

2. Theoretical framework and hypotheses

2.1. Theoretical framework

Individual adoption and use is one of the most mature streams of IS research, with several models explaining the key dependent variables of interest, technology adoption and use (Sykes et al., 2009). Research in this stream was originally rooted in psychology research, with the technology acceptance model (Davis, 1989) being the most influential (Venkatesh et al., 2003). Since MMS represent a form of new technology, psychological theories such as TPB and TAM provide a good starting point to study MMS adoption. The major predictors of adoption behavior suggested by TAM include user attitudes toward the technology, perceived ease of use, and perceived benefits. Attitude towards behavior refers to global predisposition, for or against, developing such behavior. TPB suggests additional predictors of technology adoption behavior such as perceived behavioral control, self-efficacy, and subjective norm. Perceived behavioral control represents individual perception of the availability or lack of the necessary resources and opportunities to develop a specific behavior (Ajzen and Madden, 1986). Subjective norms reflect how the user is affected by the perception of his or her individual behavior by significant references, for example, friends or colleagues, among others (Fishbein and Ajzen, 1973; Schofield, 1974). These theories primarily use beliefs as predictors of behavioral intention to use a system that in turn predicts system use (Sykes et al., 2009). Behavioral intention is the best predictor for future behavior when the behavior is volitional and individual has the information to form stable behavioral intentions (Ajzen, 1991; Karahanna et al., 1999). While these psychological theories have helped us make substantial progress in understanding adoption, their focus has primarily been on the individual-level psychological processes (Venkatesh et al., 2003, 2007).

However, adopting MMS is a *social behavior* in that it has partners to exchange with. Users of MMS frequently put the multimedia messages (photos, video clips, etc.) on their microblogs, SNS sites, or family web pages so that their friends and relatives can share the content of the messages. Thus, in order to better understand the adoption of MMS, theories explaining social behavior such as social cognitive theory and social influence theory should supplement individual psychological theories. Douglas and Craig (1992) suggest that strong theoretical and conceptual frameworks can be developed through an integration of constructs from different research traditions and disciplines.

Social influence theory emerged from research on the adoption and diffusion of communication technologies, and draws upon social information processing theory. The social influence theory mentioned in LaRose et al. (2001) suggests that information conveyed via individuals' social networks influences how they recognize a set of new information technology (Fulk, 1993). Several studies including Taylor and Todd (1995) and LaRose et al. (2001) identify social influence as an important factor in understanding information technology usage. According to social information processing theory (Salancik and Pfeffer, 1978), social information is identified as a factor influencing individual behavior. Individuals adapt their attitudes, behavior and beliefs to their social context and to the reality of their own past and present behavior and situation. As a continuation of this research trend, we believe that social influence theory is useful in explaining the use of new mobile communication services such as MMS.

Social influence theory emphasizes the roles of social culture and norms involved in communication within groups. The members of social systems interact with various modes of communications that often form and structure the context and meaning of the messages. This process often results in subjective norms that direct group members' behavior. Subjective norms focus on two individual attributes: (1) the belief that the referred person considers a particular behavior important; and (2) the motivation of the decision maker to comply with the referred persons' belief (Loraas and Wolfe, 2006). If a peer, supervisor or some other actor in a relevant social network believes that a technology is useful, through a process of shared cognition, so will a member individual. Lewis et al. (2003) also show that the potency of influence of another member varies, and often depends on the level of significance internalized by another's belief or the similarities of belief with others. In the context of MMS, individual's intention to use MMS may be affected by peer influence.

Meanwhile, social cognitive theory explains behavior in terms of reciprocal causation among individuals, their environments, and their behaviors (Bandura, 1977). Social cognitive theory is based on the premise that environmental controls, such as social pressures, unique situational characteristics, cognitive factors and other personal factors including personality, demographic and behavioral characteristics, are reciprocally determined. Furthermore, behavior in a given situation is affected by environmental or situational characteristics, which are in turn affected by the individual's behavior. Also, the behavior is influenced by cognitive and personal factors, and in turn, affects those same factors (Compeau and Higgins, 1995). The triadic causal mechanism is mediated by symbolizing capabilities that transform sensory experiences into cognitive models that guide actions. While social cognitive theory has many dimensions, this research focuses on unique situational characteristics surrounding the use of MMS. Further, since this is a cross-sectional study looking into the adoption of MMS, we limit our investigations to the one-way relationships involving the influence of environmental factors on human behavior, rather than reciprocal relationships.

As for environmental influences on the adoption of MMS, we include two factors: facilitating conditions and perceived credibility.

Facilitating conditions refer to the degree to which an individual believes that a social and technical infrastructure exists to support the use of MMS (Venkatesh et al., 2003). For example, there should be appropriate technical infrastructure to cover MMS. MMS use dedicated data traffic channels that are well suited to delivering large multimedia content, while SMS use signaling channels that should only be used for call control or other small messages. Perceived credibility refers to the degree to which users perceive MMS to be credible and secure. Before adopting MMS, users should feel comfortable that their personal messages are kept secure and protected from inappropriate uses.

In sum, this study attempts to examine MMS adoption by using TPB and TAM as the basis and social influence and cognitive theories as complements.

2.2. Hypotheses development

As business marketers emphasize building long-term relationships with their customers, perceived credibility of mobile services plays a major role in building customer relationships. Perceived credibility encompasses various dimensions such as security, availability, and consistency. Perceived credibility of MMS is especially important for those who use MMS in the context of virtual and ubiquitous computing environment. Security threat has been identified as a major barrier to the diffusion of mobile and ubiquitous businesses. Chircu et al. (2000) also assert that perceived credibility reduces the need to understand, monitor, and control the situation, and ultimately makes technology adoption easier. Therefore, perceived credibility is expected to have a direct effect on shaping user attitudes toward using MMS. Therefore, we hypothesize;

Hypothesis 1a. Perceived credibility positively influences user attitudes toward the adoption of MMS.

According to TAM, perceived benefits of using MMS are known as an important predictor of user behavior. However, when users evaluate the benefits of using MMS, they compare the costs to the benefits of using MMS. Unlike other services where the costs of using them are minimal, MMS users are often charged for every message they send. Thus, a separate consideration is needed for the costs of using MMS (Turel et al., 2007).

The perceived costs are expected to influence the attitude toward MMS usage (Kuo and Yen, 2009; Luarn and Lin, 2005). The attitude toward adopting an IT service is shaped by the individual's salient beliefs about the consequences of adopting it and evaluation of the consequences. When users perceive the costs of using MMS to be high, they will be reluctant to use MMS. It has been argued that in the process of transferring e-commerce to mobile services users have to bear various costs, namely equipment cost, access cost, and conversion cost. These costs may increase usage fees of mobile services to the level higher than that of wired e-commerce. Additionally, excessive costs of value-added service such as MMS may negatively affect consumer decisions to adopt value-added services (Erlandson and Ocklind, 1998). Previous research has found that perceived costs have significant effects on users' adoption of mobile commerce (Wu and Wang, 2005), value-added service of wireless mobile commerce (Hung et al., 2003), and mobile banking (Luarn and Lin, 2005). Therefore, we hypothesize:

Hypothesis 1b. Perceived costs negatively influence user attitudes toward the adoption of MMS.

In the current study, relative advantage is measured through behavioral intention to use IT. In innovation diffusion theory, Rogers (1995) shows that relative advantage of using an innovative technology accounts for lower costs, savings in time and effort, and decrease in discomfort. Empirical evidence suggests that relative advantage is consistently the best predictor of usage or behavioral intention to use an innovation (Choudhury and Karahanna, 2008). Drawing on innovation diffusion theory, we posit that individuals use MMS only if they perceive a relative advantage over comparable services that are already being used like SMS. There has been constant speculation that relative advantage of MMS over SMS influences the attitude toward using MMS. Therefore, we hypothesize:

Hypothesis 1c. Relative advantage positively influences user attitudes toward the adoption of MMS.

According to Davis (1989), the perceived ease of use represents an intrinsically motivating aspect between human and computer interaction. New IT services such as MMS that are perceived to be easier to use and less complex may have a higher likelihood of being adopted and used by potential users. Perceived ease of use is posited to influence attitude toward use through two causal pathways: a direct effect as well as an indirect effect through relative advantage by comparing the use of MMS to SMS. Therefore, we hypothesize:

Hypothesis 1d. Perceived ease of use of MMS positively influences user attitudes toward the adoption of MMS.

Hypothesis 2. Perceived ease of use of MMS positively influences user relative advantage of using MMS.

Taylor and Todd's study (1995) finds that peer pressure along with superior influence and social influence shape an individual's opinion and decision. Further, subjective norms and social pressures to perform or not to perform a particular behavior are also considered a factor affecting behavioral intentions (Lu et al., 2008). Research on the diffusion of innovations often discusses this social influence on an individual's decision making. Moore and Benbasat (1991) confirm this view by showing that the extent of using an innovative technology often is perceived as enhancement of status. In addition, Hsieh et al. (2008) show evidence suggesting that key members from one's social network have more chances to exchange important information. Therefore, they may exert normative influence upon one's innovation behavior. Subjective norms that shape an individual's behavior will be influenced by expectations from peer influences (Taylor and Todd, 1995). Therefore, we hypothesize:

Hypothesis 3. Peer influences positively influence subjective norms of MMS users.

Self-efficacy, the core concept of social cognitive theory, represents an individual's belief in his or her capability to perform a specific task at a specific level of performance (Lin and Huang, 2009). Bandura (1977) defines that self-efficacy is the belief in one's capabilities to organize and to execute the courses of action required to attain a goal. Bandura (1977) also argues that self-efficacy functions as a proximal determinant of one's behavior. It concerns not only the skills one has, but also the judgments of what one can do with those skills (Bandura, 1977). Several recent studies have indicated the significant relationship between self-efficacy and usage of IT (Kankanhalli et al., 2005). Hill et al. (1987) also observe that self-efficacy plays an important role in determining an individual's decision to use IT. Our interest is to test the effect of self-efficacy on perceived behavioral control. Therefore, we hypothesize:

Hypothesis 4a. Self-efficacy positively influences perceived behavioral control of MMS users.

Facilitating conditions for new information technology services involve two dimensions: resource factors, such as time and money, and technology factors, involving compatibility issues that constrain usage (Lu et al., 2008). It has been posited that behavioral intention and IT usage would be less likely when time or money is scarce and technical incompatibility exists. Facilitating condi-

tions are believed to include the availability of training and provision of support (Lu et al., 2008). It can also be viewed as an external control in the environment. Behavior cannot occur if its environment prevents it or if the facilitating conditions make the behavior difficult. Therefore, policies, regulations, and legal environments are all critical for new technology acceptance and application. Both businesses and consumers who engage in mobile data services or mobile commerce activities need legal and regulatory protections as they conduct traditional business transactions. Therefore, we hypothesize:

Hypothesis 4b. Facilitating conditions for using MMS positively influence perceived behavioral control of MMS users.

The theory of planned behavior by Schifter and Ajzen (1985) constitutes a general model explaining users' behavior reflecting their own beliefs, attitudes, and intention. This theory is an extension of the theory of reasoned action (TRA) (Fishbein and Ajzen, 1973) which focuses on cases where users have no complete control over their choices but are somehow conditioned by motivating factors related to the availability of certain requirements and resources. Thus, the TPB provides the final word for a number of authors who had previously pointed out that individual's behavior is frequently determined by some factors beyond their own control (Bandura, 1977; Crespo and Bosque, 2008). The TPB considers intention as the best indicator or foresight of human behavior, since it shows the efforts that users are willing to make to carry out a specific action (Ajzen, 1991). This study's research model identifies three kinds of variables determining or explaining behavior intention: attitudes toward behavior, subjective norms and perceived behavioral control.

According to the expectations-value model proposed by Fishbein and Ajzen (1973), attitude is the result of individual beliefs regarding behavior and their consequences, and the importance placed on these beliefs. Subjective norms arise from two basic underlying factors: the normative beliefs the user is associated with significant referents, and the motivation to behave according to these people's wishes. Finally, perceived behavioral control results from both individual beliefs regarding the factors determining behavior and from control over such factors. According to TPB, attitude, subjective norms, and perceived behavioral control are the elements that help us understand the reasons and explain the factors for individual actions. These factors have been used in research to analyze behaviors such as the adoption of mobile technology (Luarn and Lin, 2005; Lu et al., 2001). According to TRA (Ajzen and Fishbein, 1980) and TPB (Ajzen and Madden, 1986), one's attitude is a good indicator of his or her behavioral intention. Consistent with TPB, we hypothesize that attitudes, subjective norms, and perceived behavioral control affect behavioral intention. Furthermore, behavioral intention affects MMS usage behavior. Therefore, we hypothesize:

Hypothesis 5a. User attitudes toward MMS positively influence behavioral intention to adopt MMS.

Hypothesis 5b. The subjective norm which users' social communities accept toward MMS positively influences behavioral intention to adopt MMS.

Hypothesis 5c. Perceived behavioral control positively influences behavioral intention to adopt MMS.

Hypothesis 6. Behavioral intention to adopt MMS positively influences MMS usage behavior.

The research model is presented in Fig. 1.

3. Research methodology

3.1. Instrument development and data collection

An empirical investigation of current MMS users was conducted. The questionnaire consisted of two parts. The first part solicited demographic information such as age, sex, and utilized mobile services. The second presented questions pertaining to the proposed model. All the instruments had been validated in prior research studies (Choudhury and Karahanna, 2008; Hsieh et al., 2008). The instrument for intention and perceived ease of use was adapted from the work of Davis (1989). Items of peer influences and facilitating conditions were adapted from the works of Taylor and Todd (1995). To address face validity, a group of business professors, doctoral students, and industry experts were asked to read and refine the questionnaire. Based on their feedback, several items were changed to reflect the purpose of this research better. This pre-test examination provided us reasonable assurance of the validity of the scale items. All items included in the survey were measured on a five-point Likert scale. The measurement items were shown in Appendix A. Furthermore, a survey study was conducted to validate the research model via mobile phones. The target population was mobile service subscribers. The age of 1016 participants ranged from teenagers to senior citizens. Among these participants, 134 claimed to have never utilized MMS (13.2%), 625 claimed to have utilized MMS 1–5 times per month (61.5%), 130 from 6 to 10 times per month (12.8%), 58 from 11 to 30 times per month (5.7%), and 69 over 30 times per month (6.8%). Additional demographic and usage statistics are shown in Table 1.

3.2. Measurement model

We used partial least squares (PLS) to assess the scales and to test the research model and hypotheses. PLS, which uses component-based estimation, maximizes the variance explained in the dependent variable, does not require multivariate normality of the data, and is less demanding on sample size (Barclay et al., 1995). Descriptive statistics for the research constructs are shown in Tables 1 and 2. The scales are assessed in terms of item loadings, discriminant validity, and internal consistency. Item loadings and internal consistencies greater than .70 are considered acceptable (Fornell and Larcker, 1981). As evidenced by the PLS factor analysis results in Table 2 and composite reliability scores in Table 3, the scales essentially meet the .70 guidelines for internal consistencies and item loadings. All items exhibit high loadings that are greater than .70 on their respective constructs. In addition, all constructs in the model exhibit good internal consistency as evidenced by their composite reliability scores, ranging from 0.86 to 1.00.

To assess discriminant validity, indicators should load more strongly on their corresponding construct than on other constructs in the model (the loadings should be higher than cross-loadings), and the square root of the average variance extracted (AVE) should be larger than the inter-construct correlations (the average variance shared between the construct and its indicators should be larger than the variance shared between the construct and other constructs). As shown in Table 2, all indicators load more highly on their own construct than on other constructs. Furthermore, examination of the inter-construct correlations and square root of AVE (shared leading diagonal) in Table 4 reveals that all constructs share considerably more variance with their indicators than with other constructs. Thus, these results point to the convergent and discriminant validity of the constructs. All indicators load more highly on their own construct than on other constructs. Furthermore, examination of the inter-construct correlations and

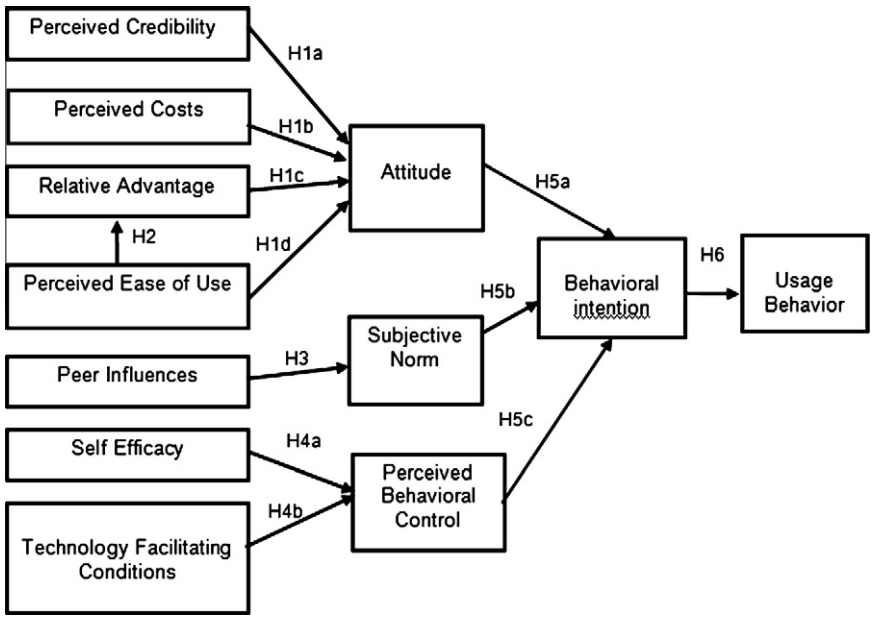


Fig. 1. Research model.

Table 1
Demographic characteristics of respondents.

Demographic profile		Frequency	Percent (%)
Gender	Male	497	48.9%
	Female	519	51.1%
Age	<20	163	16.0%
	20–29	217	21.4%
	30–39	218	21.5%
	40–49	219	21.6%
	50–59	152	15.0%
	60+	47	4.6%
Mobile service usage period	<1 year	166	16.3%
	1–2 years	134	13.2%
	2–3 years	93	9.2%
	>3 years	623	61.3%
Frequency of MMS usage	Seldom	134	13.2%
	1–5 times	625	61.5%
	6–10 times	130	12.8%
	11–30 times	58	5.7%
	Over 30 times	69	6.8%

square root of AVE reveals that all constructs share considerably more variance with their indicators than with other constructs. Thus, these results point to the convergent and discriminant validity of the constructs.

3.3. Structural model

Fig. 2 and Table 5 present the results of our study with overall explanatory power, estimated path coefficients (all significant paths are indicated with an asterisk), and associated *t*-values of the paths. As shown in Fig. 2 and Table 5, PLS results provide strong support for the effects of perceived credibility, relative advantage, and perceived ease of use on attitude toward MMS use intention (supporting H1a, 1c, and 1d). Also, relative advantage was influenced by perceived ease of use (supporting H2). All but one hypothesis linking perceived costs to attitude were supported. While peer influences have significant effects on subjective norm (supporting H3), self-efficacy and technology facilitating conditions have significant effects on perceived behavioral control (supporting H4a and 4b). The results also indicate that the paths from attitudes, subjective norms and perceived behavioral control to behavioral intention are significant (supporting H5a, 5b, and 5c). Furthermore, behavioral intention has a strong significant relationship with MMS usage behavior (*t*-statistics = 17.57; path coefficient = 0.46), providing support for H6. These findings are consistent with past studies (Hsieh et al., 2008). Following Chin (1998), bootstrapping was performed to test the statistical significance of path coefficients. As shown in Fig. 2, exogenous variables explain considerable proportions of the variance—39% for attitude, 64% for subjective norm, 48% for perceived behavioral control, 50% for behavioral intention, and 27% for usage behavior. The hypothesis results are presented in Fig. 2 and Table 5.

As a result of the PLS analysis, all hypotheses were supported except one. Drawing upon the perspectives of the social cognitive and social influence theories, this study examines the research model of MMS usage empirically. Driven by the need to understand the underlying motivation of user acceptance of MMS better, this research postulates perceived credibility, perceived costs, relative advantage, perceived ease of use, peer influences, self-efficacy, and facilitating conditions as the key determinants affecting mobile service subscribers' intention to use MMS. The measurement model confirms the measures of all constructs in the research model with adequate convergent and discriminant validity. The structural model indicates that almost all path coefficients in the model were found statistically significant. The results show that psychological traits (e.g., self-efficacy and peer influence) are important factors in shaping intention to use MMS. Individual behavioral theories such as the theory of reasoned action also significantly affect the behavioral intention (i.e., attitude, subjective norms, and perceived behavioral control) regarding MMS usage.

4. Discussion

4.1. Implications

The research presented here was motivated by the recognition that MMS are increasingly becoming a core component of individual and organizational communication, and researchers need to better understand what drives individual behaviors toward MMS.

Table 2
PLS factor analysis results (factor loadings and cross-loadings).

	CRD	PC	RA	PEU	PI	SE	TFC	ATD	SN	PBC	BI	UB
CRD1	**0.84**	0.17	0.43	0.37	0.36	0.15	0.19	0.45	0.36	0.26	0.38	0.19
CRD2	**0.89**	0.21	0.43	0.39	0.46	0.11	0.15	0.44	0.42	0.20	0.37	0.26
CRD3	**0.85**	0.20	0.41	0.37	0.37	0.12	0.15	0.42	0.37	0.19	0.37	0.19
CRD4	**0.81**	0.22	0.25	0.26	0.22	0.03	0.11	0.18	0.22	0.10	0.15	0.09
PC1	0.19	**0.79**	0.21	0.17	0.20	0.04	0.14	0.13	0.22	0.08	0.23	0.05
PC2	0.22	**0.90**	0.16	0.20	0.25	0.05	0.11	0.14	0.26	0.05	0.21	0.09
PC3	0.18	**0.83**	0.13	0.16	0.22	0.05	0.07	0.10	0.24	0.03	0.17	0.07
PC4	0.20	**0.85**	0.17	0.18	0.23	0.03	0.10	0.17	0.26	0.04	0.22	0.13
RA1	0.44	0.18	**0.89**	0.39	0.40	0.19	0.21	0.47	0.41	0.35	0.52	0.27
RA2	0.47	0.15	**0.90**	0.44	0.45	0.19	0.21	0.51	0.47	0.35	0.53	0.30
RA3	0.42	0.19	**0.89**	0.42	0.47	0.17	0.22	0.48	0.48	0.33	0.52	0.29
RA4	0.42	0.20	**0.88**	0.40	0.49	0.16	0.22	0.45	0.50	0.31	0.54	0.28
PEU1	0.39	0.18	0.44	**0.91**	0.41	0.33	0.38	0.43	0.43	0.43	0.40	0.35
PEU2	0.37	0.20	0.38	**0.91**	0.37	0.39	0.36	0.41	0.39	0.47	0.39	0.27
PEU3	0.42	0.20	0.44	**0.91**	0.45	0.31	0.39	0.44	0.47	0.44	0.43	0.33
PI1	0.42	0.25	0.47	0.40	**0.94**	0.08	0.22	0.47	0.78	0.29	0.57	0.41
PI2	0.45	0.25	0.47	0.42	**0.95**	0.09	0.23	0.48	0.75	0.29	0.58	0.42
PI3	0.41	0.24	0.42	0.39	**0.92**	0.05	0.22	0.43	0.74	0.25	0.52	0.38
PI4	0.37	0.23	0.47	0.40	**0.89**	0.10	0.22	0.46	0.72	0.33	0.56	0.39
PI5	0.41	0.24	0.49	0.44	**0.80**	0.15	0.25	0.51	0.61	0.35	0.57	0.36
SE1	0.14	0.00	0.23	0.38	0.14	**0.89**	0.44	0.27	0.15	0.69	0.30	0.21
SE2	0.09	0.03	0.11	0.28	0.05	**0.86**	0.42	0.18	0.08	0.50	0.24	0.16
SE3	0.13	0.04	0.17	0.31	0.06	**0.89**	0.40	0.23	0.07	0.55	0.26	0.17
TFC1	0.17	0.09	0.21	0.35	0.19	0.46	**0.90**	0.24	0.19	0.44	0.32	0.29
TFC2	0.16	0.13	0.23	0.39	0.26	0.40	**0.89**	0.23	0.27	0.42	0.35	0.24
ATD1	0.44	0.14	0.48	0.40	0.45	0.19	0.20	**0.89**	0.41	0.33	0.49	0.36
ATD2	0.46	0.14	0.48	0.45	0.46	0.27	0.24	**0.92**	0.42	0.39	0.56	0.39
ATD3	0.45	0.14	0.50	0.42	0.49	0.25	0.25	**0.90**	0.46	0.38	0.57	0.38
SN1	0.43	0.28	0.51	0.47	0.77	0.13	0.25	0.46	**0.98**	0.33	0.55	0.36
SN2	0.43	0.29	0.51	0.45	0.79	0.11	0.25	0.46	**0.98**	0.32	0.55	0.36
PBC1	0.27	0.07	0.40	0.49	0.34	0.61	0.42	0.43	0.33	**0.93**	0.50	0.31
PBC2	0.17	0.05	0.28	0.40	0.26	0.61	0.46	0.31	0.28	**0.91**	0.39	0.29
BI1	0.40	0.22	0.51	0.41	0.57	0.26	0.36	0.54	0.51	0.43	**0.89**	0.46
BI2	0.40	0.24	0.56	0.40	0.59	0.25	0.31	0.56	0.54	0.40	**0.93**	0.49
BI3	0.34	0.22	0.55	0.42	0.53	0.33	0.35	0.54	0.49	0.48	**0.91**	0.45
UB1	0.23	0.10	0.32	0.35	0.43	0.21	0.29	0.42	0.37	0.33	0.51	**1.00**[a]

Notes: ATD = attitude, CRD = perceived credibility, PC = perceived costs, RA = relative advantage, PEU = perceived ease of use, SN = subjective norms, PI = peer influences, PBC = perceived behavioral control, SE = self-efficacy, TFC = technology facilitating conditions, BI = behavioral intention, UB = usage behavior.
[a] Usage behavior is a single-item construct.

Table 3
Descriptive statistics.

Construct	Mean	SD	Composite reliability	AVE
Perceived credibility	3.29	1.01	0.86	0.62
Perceived costs	2.07	1.01	0.91	0.71
Relative advantage	3.30	1.04	0.94	0.79
Perceived ease of use	3.45	1.01	0.94	0.83
Peer influence	2.51	1.09	0.96	0.81
Self-efficacy	4.11	0.92	0.91	0.78
Technology facilitating conditions	3.65	1.05	0.89	0.80
Attitude	3.54	0.95	0.93	0.82
Subjective norms	2.65	1.10	0.98	0.95
Perceived behavioral control	3.80	0.97	0.92	0.85
Behavioral intention	3.15	1.13	0.94	0.83
Usage behavior	3.69	1.00[a]	1.00[a]	1.00[a]

[a] Usage behavior is a single-item construct.

Recognizing that individuals make adoption and usage decisions within complex social contexts, we sought to offer comprehensive perspectives on the factors that influence individuals' beliefs about the MMS use. To this end, we empirically examined the simultaneous effects of social and psychological factors on the adoption of MMS. The theoretical rationale for these factors drew upon multiple streams of research including individual psychology research, social cognitive theory, and social influence theory.

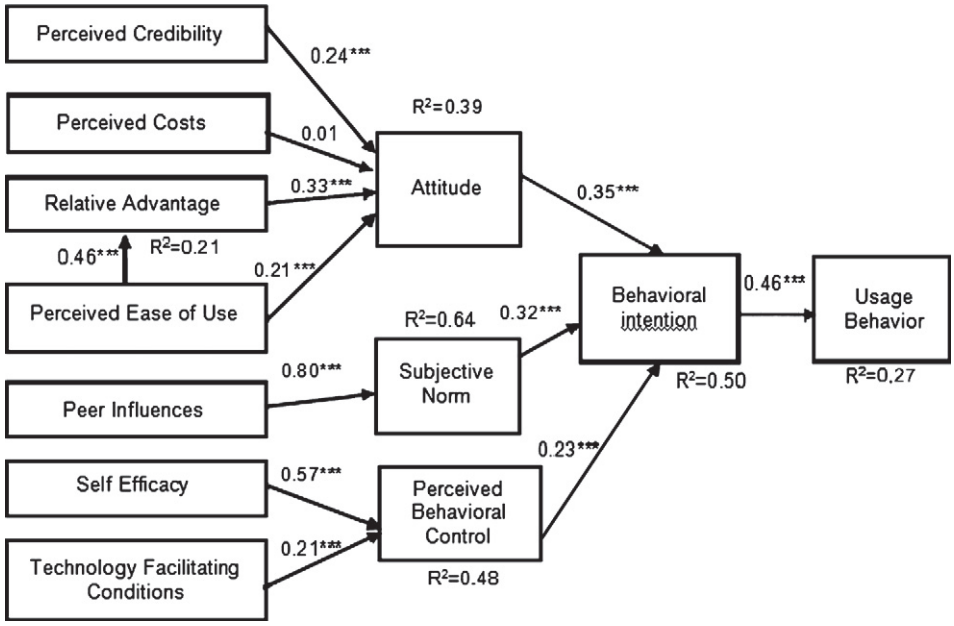
Several theoretical and practical implications follow. From the perspective of theory advancement, we provide additional evidence regarding salient predictors of MMS adoption. Our posited predictors explained between 39% and 64% of the variance in attitude, subjective norm, and perceived behavioral control and between 27% and 50% of the variance in behavioral intention and usage behavior respectively, suggesting that the model serves as an adequate conceptualization of the phenomenon of interest. Specifically, this study is one of few attempts to investigate the drivers of usage behavior of MMS by integrating social behavioral factors. The results of this study assist researchers in understanding how users form their intention to use MMS. The model was different from other usage adoption models because it includes social psychological traits that seemed to be highly relevant to the adoption of MMS. Future studies should continue to explore the interrelationships among these traits. Researchers have long suggested that social psychological factors are important in technology use behavior, but limited work has specifically examined the effects of these factors on adoption. Given that there is sufficient evidence regarding the role played by social psychological factors, researchers need to pay more attention to the placement of constructs such as social influence forces in their theoretical models.

Furthermore, this study adopts the social influence theory to explain the formation of the subjective norms. Peer influences play a key role in shaping subjective norms. The findings of this study are consistent with those of prior studies in other information communication services (Hsieh et al., 2008). The path coefficient of 0.80 between peer influence and subjective norms supports previous research. Subjective norms are primarily shaped by expectation from important referents in one's social network. The

Table 4
Inter-Construct Correlations.

	CRD	PC	RA	PEU	PI	SE	TFC	ATD	SN	PBC	BI	UB
CRD	**0.79**[a]											
PC	0.24	**0.84**										
RA	0.49	0.20	**0.89**									
PEU	0.44	0.21	0.46	**0.91**								
PI	0.46	0.27	0.51	0.45	**0.90**							
SE	0.14	0.03	0.20	0.38	0.10	**0.88**						
TFC	0.19	0.13	0.25	0.41	0.25	0.48	**0.90**					
ATD	0.49	0.16	0.54	0.47	0.52	0.26	0.26	**0.91**				
SN	0.44	0.29	0.52	0.47	0.80	0.12	0.26	0.47	**0.98**			
PBC	0.25	0.06	0.38	0.49	0.33	0.67	0.48	0.41	0.34	**0.92**		
BI	0.43	0.25	0.59	0.45	0.62	0.31	0.37	0.60	0.56	0.48	**0.91**	
UB	0.24	0.10	0.32	0.35	0.44	0.21	0.29	0.41	0.37	0.33	0.51	**1.00**[b]

[a] The bold numbers on the leading diagonal are the square root of the average variance extracted (AVE). Off-diagonal elements are the correlations among constructs. For discriminant validity, diagonal elements should be larger than off-diagonal elements.
[b] Usage behavior is a single-item construct.



Note. ***: $p < 0.01$

Fig. 2. PLS analysis results.

Table 5
Hypothesis testing results.

Path	Path coefficient	*t*-value	*p*-value	Hypothesis
CRD → ATD	0.24	7.31	0.00	Supported
PC → ATD	0.01	0.36	0.72	Not supported
RA → ATD	0.33	9.41	0.00	Supported
PEU → ATD	0.21	6.35	0.00	Supported
PEU → RA	0.46	17.15	0.00	Supported
PI → SN	0.80	58.35	0.00	Supported
SE → PBC	0.57	19.44	0.00	Supported
TFC → PBC	0.21	5.85	0.00	Supported
ATD → BI	0.35	11.76	0.00	Supported
SN → BI	0.32	11.84	0.00	Supported
PBC → BI	0.23	8.83	0.00	Supported
BI → UB	0.46	17.57	0.00	Supported

Note: ATD = attitude, CRD = perceived credibility, PC = perceived costs, RA = relative advantage, PEU = perceived ease of use, SN = subjective norms, PI = peer influences, PBC = perceived behavioral control, SE = self-efficacy, TFC = technology facilitating conditions, BI = behavioral intention, UB = usage behavior.

inclusion of peer influence in this specific context of MMS provides us with a significant explanation of the formation of behavioral intention of MMS usage. Additionally, the results indicate that perceived costs do not influence attitudes toward MMS usage behavioral intention. This finding is inconsistent with prior studies on perceived costs in information communication technology usage (Chau and Hui, 2001; Iacovou et al., 1995). Earlier studies including Lee et al. (2007) found perceived costs to be an important predictor of behavioral intention. However, there is a possible explanation for this contradiction. Since MMS are used primarily for entertainment or leisure activities, users are not as price sensitive to MMS as to work-based services. Finally, consistent with prior information systems studies, we found that behavioral intention leads to the usage of MMS. The path coefficient of 0.46 between behavioral intention and usage is consistent with those of previous investigations by Turel et al. (2007) and Taylor and Todd (1995).

As for practical implications, our findings suggest that mobile communication service providers need to focus careful attention

on exhibiting commitment to new services for contingent adoption decisions. Unless individuals perceive the services to be interesting and useful, they are unlikely to develop positive behavioral intention about the adoption of that service. As observed by others (Compeau and Higgins, 1995), it is important for technology implementers to assist individuals in developing positive perceptions about their usage of new technology. Specifically, MMS should be designed as an easy-to-use mobile communication services.

Furthermore, since MMS are used primarily for entertainment or leisure activities, practitioners' efforts should be geared toward the creation of beneficial, fun, and enjoyable experiences of MMS usage. This endeavor will maximize prospective users' tendency to adopt MMS services. Specifically, the processes of composing, sending, and receiving MMS messages need to be as simple and fun as possible, and thereby encourage users to explore the fun and amusement of using MMS services.

Finally, as suggested by Agarwal and Prasad (1997), individuals who are personally more innovative in the use of ICT could be utilized as important change agents because they are likely to exhibit positive perceptions about the technology use (Lewis et al., 2003). Our findings shed some light on potential avenues of action for promoting the diffusion of other mobile value-added services, such as mobile downloads (ring tones and icons), mobile games, etc. By addressing the key value dimensions, mobile communication service providers can drive the acceptance of MMS as well as the penetration of other mobile value-added services.

Our study enhances the understanding of the interaction of users with mobile value-added services and provides valuable insights for industry professionals. With a quarter of the world already penetrated by mobile phone users, MMS users are exploding. The potential in Asia is staggering. With the right vision, and bold, forward-thinking strategies, MMS providers are starting to realize enormous gains. MMS has become a commodity offering - one where demand is still growing. Telecom executives will always look for ways to develop new and innovative services for interactive communications. This will help secure their positions in the marketplace.

In conclusion, the primary contributions of this work are twofold. First, we extended prior research in the MMS adoption by offering a conceptual model of the drivers of behavioral intention that synthesized multiple theoretical perspectives. The focus of this integration was on the complexities of the social context within which individuals with varying characteristics form the behavioral intention. Second, we tested the effects of these drivers with an empirical study. Field data provided support for the theoretical relationships, and these results will help refine our understanding of individual behaviors toward the use of ICT.

Further, this theoretical model accounted for 50% of the variance in the behavioral intention and for 27% of the variances in usage behavior, which suggest that some important predictors may be missing. Most of these predictors include personal innovativeness (Lewis et al., 2003), perceived expressiveness (Nysveen et al., 2005), perceived service level (Liu and Ma, 2005), perceived media richness (Lee et al., 2007), availability of support services (Robinson et al., 2005) and one's cultural background (Choi and Geistfeld, 2004). Most of them are important, however, they need to be adapted to the investigation of user's continued intention to use under MMS proliferation conditions. The research model of this study has focused on respondents' intention to adopt instead of continued intention to use and there are differences between intention to adopt and continued use intention. Adopters may observe other people's use experience for their internal evaluation and adoption decision. However, there might be a correlation between social behavioral intention to use and continued use intention. Therefore, understanding the relationship between the intention to use and continued use intention is still important and desirable for future research.

4.2. Research limitations

In interpreting the results of this research, one must consider a few limitations. The first limitation is external validity because a convenience sampling was used; the target populations of MMS users were chosen from the same country. Thus, while the findings from this study may be extended to other similar technology-centered initiatives in different countries, the generalizability to other nations may be limited to a certain degree.

Second, although availability of multiple access mechanisms may influence one's usage of a specific innovation, this research, given its focus on MMS usage behavior, controlled only the most common form of mobile services. Future research should be conducted to shed more light on the impact of all the alternative access mechanisms on patterns of MMS usage.

Finally, this research represents a snapshot of the MMS usage phenomenon and attempts to predict the adoption pattern based on cross-sectional behavioral measures of MMS usage. However, the extent to which behavioral intention can be used to predict future behavior in a rapidly changing technological environment is unknown. A longitudinal study tracing individuals' pre- and post-implementation behavior may yield a richer understanding of behavioral patterns, critical factors, and how these are shaped over time.

Appendix A. Measurement items for the constructs

Perceived credibility

1. When using the MMS, I am sure that certain managerial and technological procedures exist to secure all the data being processed on this service.
2. When using the MMS, I am sure that certain managerial and technical procedures exist to protect my personal information.
3. When using the MMS, I am sure of the continuous availability (i.e., no breaking down) of this service.
4. When using the MMS, I am sure of the consistency of information processing on this service.

Perceived costs

1. I think use of the MMS in sending text messages is economical.
2. I think use of the MMS in sending picture/music is economical.
3. I think use of the MMS in sending video clips is economical.
4. I think use of the MMS is economical.

Relative advantage

1. I would find it more convenient to use the MMS rather than other communication services.
2. I would feel more confident to use the MMS rather than other communication services.
3. I would find it more convenient to use the MMS rather than the SMS.
4. I would feel more confident to use the MMS rather than the SMS.

Perceived ease of use

1. My interaction with the MMS is clear and understandable.
2. Interacting with the MMS does not require a lot of my mental effort.
3. I find the MMS easy to use.

Peer influences

1. My family thinks that I should use the MMS.
2. My relatives think that I should use the MMS.
3. My friends think that I should use the MMS.
4. People I work with think that I should use the MMS.
5. People who influence my behavior think that I should use the MMS.

Self-efficacy

1. I feel comfortable using the MMS on my own.
2. I can easily operate the MMS on my own.
3. I feel comfortable using the MMS even if there is no around me to tell me how to use it.

Technology facilitating conditions

1. Government/Corporate policies encourage use of the MMS.
2. Overall, the use of the MMS is very supportive.

Attitude
All things considered, using the MMS is

1. extremely negative. . .. . extremely positive,
2. extremely bad. . .. Extremely good,
3. extremely harmful. . .. Extremely helpful.

Subjective norms

1. People who influence me think that I should use the MMS.
2. People who are important to me think that I should use the MMS.

Perceived behavioral control

1. I have the resources, knowledge, and ability to use the MMS.
2. Using the MMS is entirely within my control.

Behavioral intention
I intend to use the MMS . . ..

1. During the next three months.
2. For sending messages during the next three months.
3. Frequently during the next three months.

Usage behavior
What is your average number of multimedia messages you send and receive per month?
(0 . . . over 30)

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