Understanding User Acceptance of Multimedia Messaging Services: An Empirical Study

Matthew K.O. Lee
Department of Information Systems, City University of Hong Kong. E-mail: ismatlee@cityu.edu.hk

Christy M.K. Cheung
Department of Finance and Decision Sciences, Hong Kong Baptist University. E-mail: ccheung@hkbu.edu.hk

Zhaohui Chen
SAP China. E-mail: zhaohui.chen@sap.com

Multimedia Messaging Services (MMS) is a new medium that enriches people's personal communication with their business partners, friends, or family. Following the success of Short Message Services, MMS has the potential to be the next mobile commerce "killer application" which is useful and popular among consumers; however, little is known about why people intend to accept and use it. Building upon the motivational theory and media richness theory, the research model captures both extrinsic (e.g., perceived usefulness and perceived ease of use) and intrinsic (e.g., perceived enjoyment) motivators as well as perceived media richness to explain user intention to use MMS. An online survey was conducted and 207 completed questionnaires were collected. By integrating the motivation and the media richness perspectives, the research model explains 65% of the variance. In addition, the results present strong support to the existing theoretical links as well as to those newly hypothesized in this study. Implications from the current investigation for research and practice are provided.

Introduction

The extensive coverage of mobile telecommunication infrastructure, the dramatic increase in mobile penetration rate, the advances in wireless communication technology, and the tremendous growth of mobile messaging volume add up to the prosperity of mobile commerce (m-commerce). M-commerce refers to electronic commerce activities conducted using mobile devices such as mobile phones or personal digital assistants (Mennecke & Strader, 2002). It is believed that Multimedia Messaging Service (MMS) will be the next promising m-commerce "killer application" (i.e., an application which provides great value to end users and therefore is popular among consumers). MMS is a natural evolution from Short Message Service (SMS) text messaging, which already has a large user base especially in Europe and Asia. It allows users to perform multimedia communication (i.e., exchanging messages containing text, graphics, images, audio clips, and even video clips) with capable mobile phones and other devices, for both information exchange and entertainment purposes. A brief summary of the characteristics of SMS and MMS is shown in Table 1.

As mobile telecommunication technology advances, MMS will become one of the most basic services of mobile communication as well as a promising m-commerce enabling service. Strategy Analysis predicted that the revenue from MMS usage will grow to US$22 billion by 2008 (Telecomworldwide, 2003). Ovum, a telecommunication consulting firm, also estimated that by the end of 2007, the global annual revenues from MMS-based services will be US$31 billion from person-to-person applications (e.g., enriched text messaging, photo sharing, and audio messaging) and US$39 billion from machine-to-person applications (e.g., entertainment services, interactive games, and any kind of information) (Secker, 2002). All these optimistic predictions, however, cannot be realized if prospective users do not readily accept and use MMS, no matter how high the penetration rate of mobile phones. It is of particular importance to understand the factors affecting user acceptance of MMS.

Thus, this article describes a study that explains user acceptance of MMS, with specific focus on the perceived media richness. The rest of the article is organized as follows. The theoretical background of this study is described in the next section. The third section introduces our research model of user acceptance of MMS. Research methodology and statistical results follow in the fourth section, and the findings are then discussed. The article concludes with a discussion of implications of the findings and directions for future studies.

Received November 1, 2005; revised November 30, 2006; January 24, 2007; accepted January 24, 2007

 ● Published online 12 September 2007 in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/asi. 20670

TABLE 1. The characteristics of Short Message Services (SMS) and Multimedia Messaging Services (MMS).

Type	SMS	MMS
Characteristics	Plain text of maximum 160 bytes (characters), in black only	Messages in multiple rich media formats with high data rate such as video, audio plus text, unlimited message size
Applications	Simple person-to-person messaging (point-to-point mode) or cell-broadcast mode	Sharing still images between phones and PCs and later simple person-to-person messaging with a visual feeling
Platform	2nd-generation (2G) mobile communication standards or above	Designed to be used in 2G, but is mainly used in 3rd-generation (3G) mobile communication standards or above
Time frame for availability[a]	1990s onward	2002 onward

[a]Mobile streams.

Theoretical Background

The theoretical grounding for the current study of user acceptance of MMS is derived from two main perspectives: motivation theory and media richness theory. As Douglas and Craig (1992) suggested, strong theoretical and conceptual frameworks can be developed through an integration of constructs from different research traditions and disciplines. Therefore, constructs provided by these two established theories are drawn upon in this investigation.

Motivation Theory

Motivation involves internal processes that give behavior its energy and direction (Reeve, 1996). Energy relates to the strength, intensity, and persistence of the behavior concerned while direction gives the behavior a specific purpose. Several conceptual perspectives have been proposed in previous studies to understand human motivation, including self-determination theory (Deci & Ryan, 1985), Abraham Maslow's (1962) hierarchy of human needs, goal theory (Ford, 1992), and flow experience (Csikszentmihalyi, 1993). Using these perspectives, one posits that behavior can be extrinsically and intrinsically motivated (Herzberg, Mausner, & Snyderman, 1959). Extrinsic motivation refers to performing an activity as a means to achieve other goals or to gain other valued outcomes rather than the activity itself (F.D. Davis, Bagozzi, & Warshaw, 1992). It refers to external incentives and rewards that motivate an individual to perform an activity (Shapira, Kantor, & Melamed, 2001). For example, the decision to use an information technology (IT) (e.g., visiting a Web site) is actually determined by the extrinsic motivation to achieve another goal (e.g., buying books online). On the other hand, intrinsic motivation refers to doing an activity for its own sake, in which the activity itself is interesting, engaging, or in some way satisfying (Deci & Ryan, 1985). Intrinsic motivation means the enthusiasm to do an activity for the reward derive from the enjoyment of the activity itself (S.A. Davis & Wiedenbeck, 2001). For example, the decision to use an IT (e.g., using a computer audio file player) is determined by an intrinsic motivation to gain the enjoyment from this process (e.g., listening to music).

Extrinsic and intrinsic motivators are two different types of drivers capable of evoking specific outcome behavior. Perceived usefulness and perceived enjoyment are typical examples of extrinsic motivation and intrinsic motivation, respectively, in the contexts of technology adoption (e.g., Davis et al., 1992; Hwang, 2005; Igbaria, Iivari, & Maragahh, 1995; Igbaria, Parasuraman, & Baroudi, 1996; Lee, Kang, & Kim, 2007; Lee, Cheung, & Chen, 2005; Wu, Chen, & Lin, 2007) or technology continuance usage (e.g., Cyr, Hassanein, Head, & Ivanov, 2007; Cyr, Head, & Ivanov, 2006; Hsu & Lu, 2007; Lin, Wu, & Tsai, 2005; Thong, Hong, & Tam, 2006). Table 2 summarizes prior research incorporating the motivational perspective into the study of IT acceptance.

Media Richness Theory

Media choice research has a long tradition in information systems research (Carlson & Zmud, 1999; Carlson & Davis, 1998; Dennis & Kinney, 1998; El-Shinnawy & Markus, 1997; Mennecke, Valacich, & Wheeler, 2000; Ngwenyama & Lee, 1997; O'Kane & Hargie, 2007; Robert & Dennis, 2005; Sivunen & Valo, 2006; Sosa, Eppinger, Pich, McKendrick, & Stout, 2002). These studies built upon the media richness theory and examined the choice, use, and impacts of communication media in organizational settings. Information technology with higher media richness is not necessarily better (Robert & Dennis, 2005). Daft and Lengel (1986) suggested that the choices between communication media will be made on the basis of the degree of uncertainty and equivocality in the communication task. Uncertainty refers to the absence of information (Shannon & Weaver, 1949), and it arises when there is a gap between the amount of information required to perform the task and the amount of information already possessed by an organization (Galbraith, 1973). On the other hand, equivocality refers to ambiguity (Daft, Lengel, & Trevino, 1987), and it arises when there is a difference between the individual frame of reference and the negotiation required to reach shared understanding. Daft and Lengel (1986) stated that rich media are more suitable for resolving equivocal situations while lean media are more suitable for reducing uncertainty. Therefore, richer media are generally preferred and used for more complex tasks (Leonard, Brands, Edmondson, & Fenwick, 1998). El-Shinnawy and Markus (1997) further suggested that the richness continuum is a function of four factors: feedback capability, cues, personalization, and language variety. Table 3 describes these four factors in detail.

DOI: 10.1002/asi

TABLE 2. Summary of prior studies incorporating motivational perspectives.

Author (Year)	IT under study	Participants	Extrinsic motivator	Intrinsic motivator
Atkinson & Kydd (1997); Study 1	WWW usage (course-related purpose)	78 undergraduate students	PU → Usage	PENJOY → Usage
Atkinson & Kydd (1997); Study 2	WWW usage (entertainment purpose)	84 graduate students	PU → Usage	PENJOY → Usage
Cyr et al. (2006)	Users' loyalty intentions toward a mobile service	60 cell phone users	PEOU → PU PEOU → PENJOY PU → BI	PENJOY → BI
Cyr et al. (2007)	Loyalty in e-Service environments	185 individuals	PEOU → PU PU → BI	PENJOY → BI
Davis et al. (1992); Study 1	WriteOne (word-processing program)	200 MBA students	PU → BI	PENJOY → BI
Davis et al. (1992); Study 2	PC-based graphics system	40 evening MBA students	PU → BI	PENJOY → BI
Fang et al. (2005/2006)	Tasks performed on wireless hand-held devices	101 individuals	PU → BI PEOU → BI PEOU → BI Perceived security → BI	PLAY → BI
Hsu & Lu (2007)	Customer loyalty in online game communities	356 online games community participants	PEOU → PENJOY PEOU → customer preference	PENJOY → customer preference PENJOY → BI
Hwang (2005)	Enterprise systems adoption	101 ERP system users	PEOU → PU PEOU → BI PU → BI	PENJOY → PEOU PENJOY → PU
Igbaria et al. (1995)	Microcomputer	450 users in Finland	PU → Frequency of use PU → Time of use PU → Number of tasks	PENJOY → Frequency of use PENJOY → Time of use PENJOY → Number of tasks
Igbaria et. al. (1996)	Microcomputer	471 professional and managers	PU → Usage	PENJOY → Usage
Lee et al. (2005)	Internet-based learning medium	544 undergraduates	PU → Attitude PU → BI PEOU → Attitude	PENJOY → Attitude PENJOY → BI
Lee et al. (2007)	Web-based negotiation support systems user acceptance	174 employees	PEOU → PU PEOU → BI PU → BI	PLAY → PEOU PLAY → BI
Lin et al. (2005)	Web site continuance use	254 undergraduate students	PU → BI	PLAY → Attitude
Moon & Kim (2001)	WWW	152 graduate students	PU → Attitude PU → BI	PLAY → BI PLAY → BI
Sun & Zhang (2006); Study 1	Employees' Acceptance of Internet-based search engines	169 employees	PU → BI PEOU → PU PEOU → BI PEOU → PENJOY	PENJOY → PU PENJOY → BI
Sun & Zhang (2006); Study 2	Students' acceptance of university Web site	194 undergraduate and graduate students	PU → BI PEOU → PU PEOU → BI	PENJOY → PEOU PENJOY → PU PENJOY → BI
Teo et al. (1999)	Internet	1,370 online responses	PU → Diversity of Internet usage PU → Frequency of Internet usage PU → Daily Internet usage	PENJOY → Diversity of Internet usage PENJOY → Frequency of Internet usage PENJOY → Daily Internet usage
Thong et al. (2006)	Mobile Internet services	811 users of mobile Internet services	PEOU → BI PU → BI	PENJOY → BI
Van der Heijden (2004)	Dutch movie Web site	1,144 users	PU → BI PEOU → BI	PENJOY → BI
Van der Heijden (2003)	Dutch generic portal site	828 respondents	PU → Attitude	PENJOY → Attitude
Venkatesh et al. (2002)	Virtual workplace system (game-based training vs. traditional training)	knowledge workers	PU → BI	Intrinsic Motivation → PEOU Intrinsic Motivation → PU Intrinsic Motivation → BI
Venkatesh (2000); Study 1	Online help desk	70 employees in a medium-sized e-store	PU → BI	PENJOY → PEOU PLAY → PEOU
Venkatesh (2000); Study 2	Multimedia system	160 employees in a large real estate agency	PU → BI	PENJOY → PEOU PLAY → PEOU
Venkatesh (2000); Study 3	PC based environment for payroll application	52 employees in a medium-sized financial services firm	PU → BI	PLAY → PEOU PENJOY → PEOU

continued

DOI: 10.1002/asi

TABLE 2. (Continued)

Author (Year)	IT under study	Participants	Extrinsic motivator	Intrinsic motivator
Wu et al. (2007)	End user computing acceptance	142 individuals	PU Usage PEOU PU PEOU Usage	PENJOY PEOU PENJOY PU PENJOY Usage
Yi & Hwang (2003)	Web-based class management system	109 students	PEOU → PU PEOU → BI PU → BI	PENJOY → PEOU PENJOY → PU PENJOY → Self-efficacy
Yu et al. (2005)	Television commerce	947 experienced users and 115 inexperienced users	PU → BI PU → Attitude	PENJOY → BI PEOU → PU

Note. BI = behavioral intention, PEOU = perceived ease of use, PU = perceived usefulness, PENJOY = perceived enjoyment, PLAY = perceived playfulness.

TABLE 3. The function of richness continuum.

Factors	Description
Immediate feedback	The greater the medium's ability to provide timely feedback, the richer it is.
Cues	The greater the medium's ability to convey cues (e.g., sight, sound, touch), the richer it is.
Language variety	The greater the medium's ability to encompass the variety offered by natural language (e.g., the use of a variety of signs and symbols in written form and the use of a variety of language formats in spoken form), the richer it is.
Personal focus	The greater the medium's ability to encompass the variety offered by personal feelings (e.g., sociable, sensitive, warm, and personal), the richer it is.

Research Model

The Motivational Model (Davis et al., 1992) that incorporates perceived enjoyment (an intrinsic motivator) into the traditional technology acceptance model (Davis, 1989) provides us with a good start to investigate user acceptance of MMS. To capture the characteristics of MMS, perceived media richness is included in the proposed research model. Figure 1 depicts the theoretical model for the study. The following sections will elaborate on the theory and derive the hypotheses.

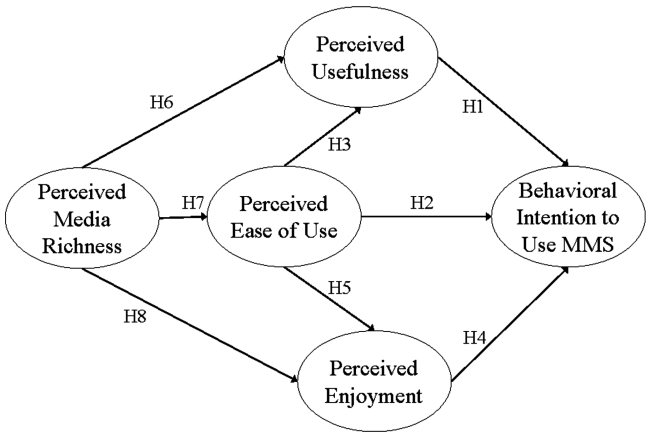

FIG. 1. The research model.

Extrinsic Motivation

From the extrinsic motivation perspective, a behavior is driven by its perceived values and the benefits derived. Davis et al. (1992) maintained that perceived usefulness and perceived ease of use are examples of extrinsic motivation, and observed that if users perceive an information system to be useful and easy to use, they are more likely to use it. They also found that individuals' perceived usefulness increases with their perceived ease of use. A review of research on technology acceptance (Lee, Kozar, & Larsen, 2003) revealed that impacts of perceived usefulness and perceived ease of use on IT adoption and usage remain consistent and significant across different settings. In fact, these two factors are widely employed in research studies on technology acceptance, from e-mail (e.g., Davis, 1989) and voice mail (e.g., Chin & Todd, 1995) to online shopping (e.g., Gefen, Karahanna, & Straub, 2003; Koufaris, 2002) and television commerce (Yu, Ha, Choi, & Rho, 2005). Similar to any new technology, it is expected that mobile phone service subscribers' decision to adopt and use MMS also is determined by their perception of its usefulness and ease of use. Indeed, users have recognized some features of MMS that are useful to their usage (Nokia, 2000). For example:

- When users are too lazy to type a short text message, or when they want to send a birthday song to their friends, they send out an audio message, which delivers more cues than traditional text messages.
- Users who want to keep in touch with their mates send vivid cartoon icons by a few punches of buttons rather than writing long, dull text messages.
- When users are traveling in other cities, they can download the city map to help them to locate different spots. They also can show the others the beautiful scene by sending their friends MMS messages with pictures and video clips of the spot.

The discussion of the values of perceived usefulness and perceived ease of use as extrinsic motivators of MMS usage guides us to come up with the following hypotheses:

H1: Perceived usefulness has a positive impact on behavioral intention to use MMS.

H2: Perceived ease of use has a positive impact on behavioral intention to use MMS.

DOI: 10.1002/asi

H3: Perceived ease of use has a positive impact on perceived usefulness.

Intrinsic Motivation

From the intrinsic motivation perspective, behavior is evoked from the feelings of pleasure, joy, and fun. Numerous studies, as shown in Table 2, have demonstrated the need to include intrinsic motivation to explain IT acceptance. These studies found that perceived enjoyment, an intrinsic motivator, has a significant effect on end users' intention to use a word-processing program (Davis et al., 1992), Internet-based learning medium (Lee et al., 2005), instant messaging (Li, Chau, & Lou, 2005), mobile data services (Hong, Tam, & Kim, 2006), and so on. It is therefore expected that the same proposition also applies to MMS.

Perceived enjoyment refers to "the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated" (Davis et al., 1992, p.1113). The perceived enjoyment of using MMS derives from two aspects. The first aspect comes from the interaction with the other parties using the same telecommunication technology for both business and entertainment purposes. MMS allows messages to be delivered in different formats, with different language and content varieties. For example, instead of text-based messages, a weather report can be presented in a list of figures with supplementary cartoon icons, stock quotes can be exhibited in graphical representation, and football goals can be preserved in the form of video clips. All these richer features of MMS provide users with a more enjoyable feeling from its usage. Perceived enjoyment is therefore a determinative intrinsic motivation behind individuals' decision to use MMS. As are result, the following hypothesis is generated:

H4: Perceived enjoyment has a positive impact on behavioral intention to use MMS.

In this study, we postulate that perceived enjoyment in using MMS strongly depends positively on perceived ease of use (or negatively on perceived complexity). Fundamental understanding of the nature and the characteristics of anything is a critical antecedent of the formation of sentiment and preference for that particular object. If one has a higher degree of self-competence in using a new technology (and thus perceives that it is easy to use), he or she is more likely to have an enjoyable feeling in using it (Bandura, 1977). Previous studies also have found that perceived enjoyment and perceived ease of use are highly related (e.g., Lee et al., 2005; Li et al., 2005; Venkatesh, Speier, & Morris, 2002; Yi & Hwang, 2003; Yu et al., 2005). Hence, we have reached the following hypothesis:

H5: Perceived ease of use has a positive impact on perceived enjoyment.

Perceived Media Richness

Media richness (i.e., information richness) refers to the channels' relative ability to convey messages that communicate rich information. When we compare the four components of the media richness concept (El-Shinnawy & Markus, 1997) with the characteristics of MMS, we notice that MMS is a very rich, yet inexpensive, communication medium (see Table 4). First, MMS has a very high capacity to convey multiple cues. MMS can easily convey static visual cues through the wordings in text messages, dynamic verbal cues through the tone of voice and inflections in audio messages, and dynamic visual and verbal cues through gestures and facial expressions in video messages. Second, the interactive capabilities of MMS also facilitate language variety and language content. Finally, the nature of MMS facilitates the transmission of feelings and emotions. For example, users can easily send personal messages (e.g., photo messages) to their friends.

Previous studies have found that a medium that allows sending and receiving rich information with multiple cues is more likely to be perceived as useful (e.g., Karahanna & Limayem, 2000; Lim & Benbasat, 2000) and less effort will be needed to use it. The higher the communication media's richness, the better the communication work can be done with less uncertainty and ambiguity, the less effort will be needed to use it, and the higher playfulness will be perceived to be for using it.

Information usage processes have been intensively studied at the level of individuals (e.g., Taylor, 1968). When faced with information needs, people attempt to bridge the gap by defining and making sense of the situation, and then taking necessary actions (Dervin & Nilan, 1986). In the context of MMS, users mostly have a higher expectation on their information use through the medium. For instance, Nokia (2000) suggested that the popularity of MMS-based services captures traditional media spent for specific services such as breaking news, travel, and weather reports from television, the Internet, and other media. The richness of this medium enhances user perception of its usefulness to fulfill their special needs of the information. Another important feature of m-commerce is its ability to deliver customized services. MMS function facilitates mobile phone service subscribers to deliver more personalized messages (i.e., information) than traditional SMS function. For example, using a built-in camera, users are able to take personalized photos and send them in messages or e-mail. Similar to the Web environment, customization in m-commerce gives consumers a value-added and enjoyable experience (Katerattanakul, 2002). In sum, all these enriched and interactive features of MMS can enhance users' enjoyable perception about its usage. Therefore, we expect that perceived media richness of MMS will have a positive influence on individuals' perception on MMS usefulness, ease of use, and enjoyment. Consider the following hypotheses:

H6: Perceived media richness has a positive impact on perceived usefulness of using MMS.

H7: Perceived media richness has a positive impact on perceived ease of use of using MMS.

H8: Perceived media richness has a positive impact on perceived enjoyment of using MMS.

DOI: 10.1002/asi

TABLE 4. The richness of Multimedia Messaging Services (MMS).

Factors	Assessment	Medium richness
Immediate feedback	1. MMS messages are not delivered in real time. 2. The actual experience with MMS are: *The sender sends a message to the Multimedia Service Centre (MMSC) When the MMSC receives the message, the MMSC sends confirmation to the sender. MMSC then sends the receiver a notification that a newmessage is waiting. The receiver can download the message any time he or she wants. Once the message is successfully downloaded, the receiver receives another confirmation message.* 3. MMS messages can be sent to/ from e-mail.	No
Cues	MMS defines a way to send and receive wireless messages that include images, These audio, and video clips in addition to text. messages have a higher capability to deliver cues such as vocal inflection or gestures.	Yes
Language variety	MMS defines a way to send and receive wireless messages that include images, audio, and video clips in addition to text. These messages allow users to include a variety of signs and symbols in written form or a variety of language formats in spoken form.	Yes
Personal focus	MMS defines a way to send and receive wireless messages that include images, audio, and video clips in addition to text. The nature of MMS facilitates the transmission of feelings and emotions. For example, users can easily send personal messages (e.g., photo messaging) to their friends.	Yes

Methodology

Data were collected using a self-administrative questionnaire distributed online to a group of business undergraduate students in a local university in Hong Kong. Online survey design has the advantages of speeding up large amounts of data collection and allowing for electronic data entry (Parasuraman & Zinkhan, 2002). The study was conducted in Hong Kong because its high mobile penetration rate makes it is an ideal place to conduct research on m-commerce. Although employing a student sample is usually believed to cause a generalization problem, recruiting student participants in this study was justified by the fact that they are the potential MMS users. According to recent figures (Cellular-News.com, 2003), messaging services are more popular among the younger generation. Users under 22 years of age recorded the highest usage of mobile messaging service. These students will eventually become the most active mobile telecommunication users and influential consumers in the market in the near future. The findings of the study are anticipated to provide a further understanding of the user's perception in the market for both practical marketing and future academic-research purposes. Participation in this study was voluntary, and 207 usable questionnaires were collected. The demographic profile of the respondents is reported in Table 5.

Measures

Table 6 presents a summary of constructs and measures used for this study. We used items which were validated in

TABLE 5. Profile of the respondents.

Gender		
Male	97	46.9%
Female	110	53.1%
Age		
18 or under	1	0.5%
19–24	197	95.2%
25–34	9	4.3%
Ownership of mobile phone		
Yes	195	94.2%
No	12	5.8%

DOI: 10.1002/asi

TABLE 6. List of measures.

Construct	Items	Factor loadings
Behavioral intention (BI)	BI1: I plan to use MMS if I have an MMS enabled phone in the future.	0.87
CR = 0.92 AVE = 0.77	BI2: I intend to use MMS in the future.	0.90
	BI3: All things considered, I intend to use MMS frequently in the future.	0.87
Perceived media richness (PMR)	MMS have the ability to:	
CR = 0.91 AVE = 0.56	PMR1: Give and receive timely feedback.	0.62
	PMR2: Design messages to my own or others' requirement.	0.73
	PMR3: Transmit a variety of different cues beyond the pure text messages.	0.80
	PMR4: Use rich and varied language.	0.69
	PMR5: Design messages to your own or others' personal situation.	0.83
	PMR6: Convey multiple types of information.	0.78
	PMR7: Transmit varied symbols.	0.78
	PMR8: Provide immediate feedback.	0.71
Perceived enjoyment (PENJOY)	PENJOY1: I think I will be flexible when I use MMS.	0.80
CR = 0.94 AVE = 0.71	PENJOY2: I think I will be playful when I use MMS.	0.83
	PENJOY3: I think I will be creative when I use MMS.	0.82
	PENJOY4: I think I will be enjoyable when I use MMS.	0.86
	PENJOY5: I think I will be pleasant when I use MMS.	0.85
Perceived usefulness (PU)	PU1: Using the MMS will be advantageous for me to communicate with others.	0.85
CR = 0.83 AVE = 0.63	PU2: I think MMS will be useful for me to communicate with others.	0.87
	PU3: The MMS will be of no benefit for me to communicate with others.	0.64
Perceived ease of use (PEOU)	PEOU1: It will be easy to get MMS to do what I want.	0.83
CR = 0.83 AVE = 0.62	PEOU2: It will be impossible to use MMS without expert help.	0.64
	PEOU3: Learning to operate MMS will be easy for me.	0.87

Note. CR = composite reliability, AVE = average variance extracted, MMS = Multimedia Messaging Services.

prior research, with minor modifications of the wording of the questions to fit them into this particular context of MMS usage. Measures of perceived usefulness, perceived ease of use, and behavioral intention were borrowed from Davis (1989). Other scales, as shown in Table 6, were adapted from Webster and Martocchio (1992), Webster and Trevino (1995), and Short, Williams, and Christie (1976). All these measures were phrased as questions on a Likert scale from 1 (*strongly disagree*) to 7 (*strongly disagree*).

Data Analysis

Data analysis was done in a holistic manner using Partial Least Squares (PLS). The PLS procedure (Wold, 1985) has been gaining interest and use among researchers in recent years because of its ability to model latent constructs under conditions of nonnormality and small-to-medium sample sizes (Chin, 1998; Chin & Gopal, 1995; Compeau & Higgins, 1995). It allows one to both specify the relationships among the conceptual factors of interest and the measures underlying each construct, resulting in a simultaneous analysis of (a) how well the measures relate to each construct and (b) whether the hypothesized relationships at the theoretical level are empirically true. This ability to include multiple measures for each construct also provides more accurate estimates of the paths among constructs which are typically biased downward by measurement error when using techniques such as multiple regression. Thus, we chose the PLS-Graph version 3.00 (Chin, 1994) to perform the analysis in this study. Some technical terms are defined and explained in the Appendix.

Results

Following the two-step analytical procedures (Hair, Tatham, Anderson, & Black, 1998), we first examined the measurement model and then the structural model. The rationale of this two-step approach was to ensure that our conclusion on structural relationship was drawn from a set of measurement instruments with desirable psychometric properties.

The Measurement Model

Convergent validity indicates the extent to which the items of a scale that are theoretically related should correlate highly. Composite reliability and average variance extracted are the two most common indices for convergent validity of measures. Composite reliability of a construct is a commonly used measure to check whether the candidate scale items measure the construct in question or other (related) constructs, and a composite reliability of 0.70 or above is deemed acceptable (Fornell & Larcker, 1987). Average variance extracted reflects the overall amount of variance in the indicators accounted for by the latent construct, and an

DOI: 10.1002/asi

average variance extracted of more than 0.50 is deemed acceptable (Fornell & Larcker, 1987). Table 6 summarizes the factor loadings, composite reliability, and average variance extracted of the measures of the research model. All items have significant path loadings at the 0.01 level and fulfill the recommended levels of the composite reliability and average variance extracted.

Discriminant validity is the extent to which the measure is not a reflection of other variables. Testing for discriminant validity involves checking whether the items measure the construct in question or other (related) constructs. Discriminant validity was verified with the squared root of the average variance extracted for each construct higher than the correlations between it and all other constructs (Fornell & Larcker, 1987). As shown in Table 7, each construct shares greater variance with its own block of measures (i.e., the sets of indicators of the latent variables) than with the other constructs representing a different block of measures.

To further validate the instrument, the cross-loading method was performed to assess the discriminant validity of the scales. Loadings measure the correlations between latent variable component scores and the indicators of other latent variables when cross-loadings measure the correlations between latent variable component scores and the indicators of the same latent variable. Table 8 reports the loading and cross-loading of all reflective measures in the model. Searching down the columns, item loadings in the corresponding columns are all higher than loadings of the other items used to measure other constructs. Furthermore, when searching across the rows, the item loadings are higher for their corresponding constructs than for others. Therefore, our measurements satisfy the two following criteria for discriminant validity, as suggested by Chin (1998):

> If an indicator loads higher with other LVs than the one it is intended to measure, the researcher may wish to reconsider its appropriateness because it is unclear which construct or constructs it is actually reflecting. Furthermore, we should expect each block of indicators to load higher for its respective Latent Variable (LV) than indicators for other LVs. (p. 321)

Overall, these results provide strong empirical support for the reliability and convergent validity of the scales of our research model.

TABLE 7. Correlations between constructs.

Construct	BI	PEOU	PENJOY	PU	PMR
Behavioral intention (BI)	**0.88**				
Perceived ease of use (PEOU)	0.73	**0.79**			
Perceived enjoyment (PENJOY)	0.61	0.60	**0.84**		
Perceived usefulness (PU)	0.71	0.63	0.62	**0.79**	
Perceived media richness (PMR)	0.46	0.51	0.50	0.52	**0.75**

Note. Diagonal elements are square roots of the average variance extracted.

TABLE 8. Loadings and cross-loadings of reflective measures.

	BI	PEOU	PU	PENJOY	PMR
BI1	**0.87**	0.63	0.68	0.57	0.46
BI2	**0.90**	0.71	0.63	0.54	0.40
BI3	**0.87**	0.60	0.59	0.50	0.37
PEOU1	0.66	**0.82**	0.49	0.52	0.41
PEOU2	0.41	**0.74**	0.36	0.33	0.25
PEOU3	0.60	**0.85**	0.59	0.52	0.49
PU1	0.60	0.48	**0.85**	0.51	0.44
PU2	0.65	0.61	**0.87**	0.55	0.46
PU3	0.41	0.38	**0.75**	0.38	0.31
PENJOY1	0.47	0.50	0.50	**0.80**	0.35
PENJOY2	0.52	0.50	0.50	**0.84**	0.40
PENJOY3	0.41	0.42	0.49	**0.82**	0.38
PENJOY4	0.53	0.50	0.48	**0.86**	0.41
PENJOY5	0.59	0.55	0.57	**0.85**	0.42
PMR1	0.27	0.24	0.28	0.28	**0.62**
PMR2	0.26	0.32	0.30	0.31	**0.73**
PMR3	0.36	0.42	0.41	0.43	**0.80**
PMR4	0.25	0.30	0.29	0.25	**0.69**
PMR5	0.41	0.45	0.44	0.40	**0.83**
PMR6	0.37	0.40	0.40	0.38	**0.78**
PMR7	0.41	0.44	0.48	0.47	**0.78**
PMR8	0.38	0.40	0.40	0.34	**0.71**

Note. BI = Behavioral intention, PEOU = Perceived ease of use, PU = Perceived usefulness, PENJOY = Perceived enjoyment, PMR = Perceived media richness.

The Structural Model

Figure 2 presents the results of our study with overall explanatory power, estimated path coefficients (All significant paths are indicated with an asterisk.), and associated t value of the paths. Tests of significance of all paths were performed using the bootstrap resampling procedure. As shown in Figure 2, the model explained 64.7% of the variance, and all hypothesized paths in the research model are statistically significant at a 95% significance level.

Among the three beliefs, perceived ease of use posited the strongest impact ($\beta = 0.42$, $t = 6.52$) on behavioral intention, followed by perceived usefulness ($\beta = 0.36$, $t = 4.94$)

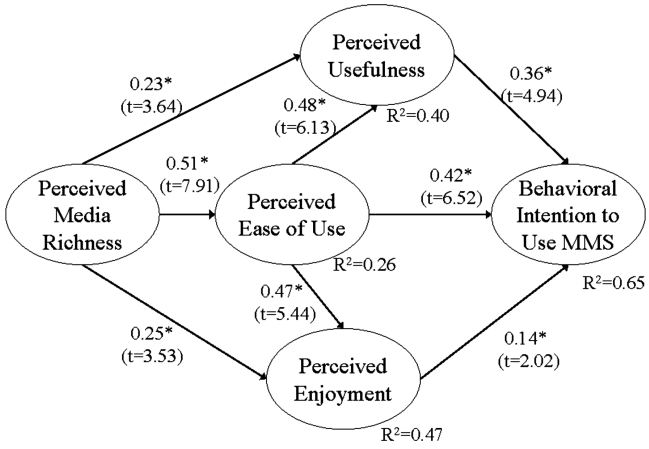

FIG. 2. Results of the PLS analysis. ($p < 0.05$)

DOI: 10.1002/asi

and perceived enjoyment ($\beta = 0.14$, $t = 2.02$). The results provide support for H1, H2, and H4. The findings also indicate that perceived ease of use exhibited a statistically significant impact on both perceived usefulness ($\beta = 0.48$, $t = 6.13$) and perceived enjoyment ($\beta = 0.47$, $t = 5.44$), supporting H3 and H5, respectively. Perceived media richness had a significant effect on perceived usefulness ($\beta = 0.23$, $t = 3.64$), perceived ease of use ($\beta = 0.51$, $t = 7.91$), and perceived enjoyment ($\beta = 0.25$, $t = 3.53$), providing support for H6, H7, and H8, respectively.

Discussion and Conclusions

Motivated by the need to better understand the underlying drivers of user acceptance of MMS, this research builds upon the motivation theory and the media richness theory and postulates perceived usefulness, perceived ease of use, and perceived enjoyment as key user beliefs affecting mobile phone service subscribers' intention to use MMS. These beliefs of MMS usage are, in turn, explained by perceived media richness. In this study, the measurement model is confirmed with adequate convergent and discriminant validity regarding the measures of all constructs in the research model. The structural model provides a good fit, and all path coefficients in the model were found statistically significant. The results show that both extrinsic (e.g., perceived usefulness and perceived ease of use) and intrinsic (e.g., perceived enjoyment) motivators are important to the formation of intention to use MMS. Perceived ease of use had a significant impact on both perceived usefulness and perceived enjoyment. Perceived media richness significantly affected the shaping of the beliefs (i.e., perceived usefulness, perceived ease of use, and perceived enjoyment) regarding MMS usage.

Implications for Theory and Research

In response to the call for a holistic model explaining acceptance of new technologies (Legris, Ingham, & Collerette, 2003), this study adopts the motivation and media richness perspectives to explain user acceptance of MMS. To our knowledge, this study is one of the very few that has attempted to investigate the drivers of user acceptance of MMS using the refined Motivational Model. In so doing, this research has broadened the boundary of the Motivational Model and has enriched the emerging IT adoption literature by examining the influences of media richness as well as extrinsic and intrinsic motivators to prospective users' acceptance to an information technology. The overall model explains 65% of the variance in user intention of MMS. The results of this study greatly assist researchers in understanding how users form their intention to use MMS.

The first part of the research model attempts to explain user intention to use MMS from the motivation perspective. The results are rather consistent with previous findings (e.g., Davis et al., 1992). Extrinsic motivators (e.g., perceived usefulness and perceived ease of use) remain as dominant factors affecting mobile phone service subscribers' intention to use MMS whereas perceived enjoyment also was found to have a significant impact on their intention to use MMS. Previous studies (e.g., van der Heijden, 2004; Venkatesh, 2000; Venkatesh & Davis, 2000) have demonstrated the importance of employing the motivation perspective in understanding user acceptance of new technologies. These efforts have significantly contributed to the variance explained in the research model. In addition, the interrelationships among the three motivators were statistically significant. Perceived ease of use exhibited a strong impact on both perceived usefulness and perceived enjoyment. The results are consistent with previous studies (e.g., Lee et al., 2005; Li et al., 2005; Nysveen, Pedersen, & Thorbjornsen, 2005a; Sun & Zhang, 2006; van der Heijden, 2004; Venkatesh et al., 2002; Yi & Hwang, 2003; Yu et al., 2005). Future studies should continue to explore the interrelationships among these three motivators.

The second part of the research model adopted the media richness theory to explain the formation of the motivation constructs. Perceived media richness has long been the key construct that theorists employ to study communication mediums (e.g., e-mail, voice mail, facsimile, and videoconferencing). The findings of this study are consistent with those of prior studies in other electronic communication environments (e.g., Karahanna & Limayem, 2000; Lim & Benbasat, 2000). The inclusion of the concept of media richness in this specific context of MMS provides us with a significant explanation of the formation of cognitive beliefs about MMS usage.

The study results indicate that perceived ease of use had a stronger effect on the intention to use MMS than that of perceived usefulness. This finding is inconsistent with a number of prior studies (e.g., Davis, 1989; King & He, 2006; Ma & Liu, 2004; Venkatesh, 1999). There are two possible explanations for this contradiction. First, MMS is used primarily for entertainment or leisure activities, so its usefulness is not as important as work-based applications, which were the focus of earlier studies that found usefulness to be the most important predictor of behavioral intentions. Second, MMS is not one single information technology but a collection of innovative information technologies which simultaneously deals with text, images, animation, graphics, audio clips, and video clips. Users may not be able to simultaneously handle all types of media, especially when they intend to send versus receive an MMS message comprising different media types. In addition, each application may be more or less useful in different ways. Thus, the measure of usefulness would be weakened because it is a composite of different views. Therefore, users tend to perceive that ease of use of MMS is more important than its usefulness in adopting this service.

Implications for Practice

While this study leads to several interesting implications for theory and research, it is also relevant for practitioners. First, MMS should be designed as an easy-to-use information

DOI: 10.1002/asi

technology. Perceived ease of use is a dominant factor affecting mobile phone service subscribers' MMS adoption intention. It also exhibits a strong impact on the other two determinants of MMS adoption intention, perceived usefulness and perceived enjoyment. The designers and the engineers of m-commerce applications or mobile devices should consider the importance of perceived ease of use for better user acceptance. For example, mobile phone manufacturers can produce mobile phones with humanized interfaces such as easy-to-push buttons, touch screens, and voice command and control systems. Likewise, mobile phone application developers can provide a straightforward, user-friendly, flexible, and easy-to-navigate user interface which allows even inexperienced users to easily and quickly send and receive MMS messages. The effects of enhanced ease of use are twofold: An easy-to-use MMS not only directly raises the prospective MMS users' intention to adopt MMS but also lifts users' perceptive usefulness and perceived enjoyment on MMS and hence indirectly stimulates their intention to indirectly adopt MMS.

Second, given that perceived usefulness is another important factor affecting prospective users' intention to use MMS, practitioners should spend some effort in increasing users' perception on the usefulness of MMS, either by adding functional capabilities in their products or by making it easier to invoke existing functions. For example, mobile phone content providers should offer innovative value-added services to both existing and prospective MMS users. Similarly, mobile phone service providers need to sensitize and educate customers about the benefits of using MMS by providing an online tutorial attempting to provide users with some basic concepts of MMS. On the other hand, since perceived usefulness is affected by perceived ease of use, the service providers need to make the menu structure and navigation more intuitive so that users can access the services easily and experience the benefits from MMS usage.

Third, since perceived enjoyment also was found to have a significant impact on users' intention to use MMS, the goal of practitioners should be the creation of beneficial, fun, and enjoyable experiences of MMS usage to maximize prospective users' tendency to adopt the technology. Then again, perceived enjoyment was significantly determined by perceived ease of use. Mobile phone users expect the processes of composing, sending, and receiving MMS messages to be as simple as possible, and thereafter can explore the fun and amusement of using different MMS services. The practitioners' job is therefore to remove the obstacles of using MMS services by providing more encouragement and technical support to both existing and prospective MMS users.

Finally, in response to the finding that perceived media richness significantly affects shaping of beliefs (e.g., perceived usefulness, perceived ease of use, and perceived enjoyment) regarding MMS usage, practitioners should endeavor to raise users' perceived media richness of MMS. In this regard, mobile phone service providers should allow users to update and download new features such as font types, icons, multimedia contents, and so on regularly. Practitioners also should work on packaging and presenting MMS as a useful and easy-to-use platform that provides a rich variety of new applications covering useful information, sports, news, weather forecasts, entertainment, and games that users might enjoy. Additionally, practitioners should educate customers on the benefits inherent in MMS, such as full content versatility and personal content creation.

Limitations and Future Research

In interpreting the results of this research, one must consider a number of limitations. The first limitation might have been introduced by the omission of important variables. The theoretical model accounts for 65% of the variance in behavioral intention, which suggests that some important predictors may be missing. Most of these predictors are individual factors, including perceived expressiveness (e.g., Nysveen et al., 2005a; Nysveen, Pedersen, & Thorbjornsen, 2005b), computer self-efficacy (e.g., Lewis, Agarwal, & Sambamurthy, 2003; Venkatesh & Davis, 1996), personal innovativeness (e.g., Lewis et al., 2003; Robinson, 2005), and perceived service level (e.g., Liu & Ma, 2005). Social influences also play a role in determining behavioral intention, such as perceived control (e.g., Lewis et al., 2003; Robinson, 2005) and social norms (e.g., Robinson, 2005). Other external factors include availability of support services (e.g., Robinson, 2005) as well as one's cultural background (e.g., Choi & Geistfeld, 2004).

The second limitation is related to the fact that the data were collected from university students in a high mobile-phone-penetration city. Although the recruitment of university students as research participants in this study is justified by the fact that they are the major MMS adopters, a replication of this study with other age groups and in other countries will provide a better picture of the phenomenon.

A final limitation is that the current research was in a cross-sectional setting, attempting to predict the adoption pattern based on cross-sectional measures of behavioral intention 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. Thus, longitudinal studies are needed to examine individual actual adoption behavior, which could fine tune our current model in explaining user adoption behavior of MMS.

References

Atkinson, M.A., & Kydd, C. (1997). Individual characteristics associated with World Wide Web use: An empirical study of playfulness and motivation. DATABASE for Advances in Information Systems, 28(2), 53–62.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84(2), 191–215.

Carlson, J.R., & Zmud, R.W. (1999). Channel expansion theory and the experiential nature of media richness perceptions. Academy of Management Journal, 42(2), 153–170.

DOI: 10.1002/asi

Carlson, P.J., & Davis, G.B. (1998). An investigation of media selection among directors and managers: From "self" to "other" orientation. MIS Quarterly, 22(3), 335–362.
Cellular-News.com. (2003). Hong Kong looks to the youth to drive data services. Retrieved January 20, 2007, from http://www.cellular-news.com/story/8737.php
Chin, W.W. (1994). PLS Graph manual.
Chin, W.W. (1998). The partial least squares approach for structural equation modeling. In G.A. Marcoulides (Ed.), Modern methods for business research (pp. 295–336). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
Chin, W.W., & Gopal, A. (1995). Adoption intention in GSS: Relative importance of beliefs. DATABASE for Advances in Information Systems, 26(2&3), 42–64.
Chin, W.W., & Todd, P.A. (1995). On the use, usefulness, and ease of use of structural equation modeling in MIS research: A note of caution. MIS Quarterly, 19(2), 237–246.
Choi, J., & Geistfeld, L.V. (2004). A cross-cultural investigation of consumer e-shopping adoption. Journal of Economic Psychology, 25(6), 821–838.
Compeau, D.R., & Higgins, C.A. (1995). Computer self-efficacy: Development of a measure and initial test. MIS Quarterly, 19(2), 189–211.
Csikszentmihalyi, M. (1993). The evolving self: A psychology for the third millennium. New York: HarperCollins.
Cyr, D., Hassanein, K., Head, M., & Ivanov, A. (2007). The role of social presence in establishing loyalty in e-Service environments. Interacting with Computers, 19(1), 43–56.
Cyr, D., Head, M., & Ivanov, A. (2006). Design aesthetics leading to m-loyalty in mobile commerce. Information & Management, 43(8), 950–963.
Daft, R.L., & Lengel, R.H. (1986). Organizational information requirement, media richness and structural design. Management Science, 32(5), 554–571.
Daft, R.L., Lengel, R.H., & Trevino, L.K. (1987). Message equivocality, media selection, and manager performance. MIS Quarterly, 11(3), 355–366.
Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319–340.
Davis, F.D., Bagozzi, R.P., & Warshaw, P.R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. Journal of Applied Social Psychology, 22(14), 1111–1132.
Davis, S.A., & Wiedenbeck, S. (2001). The mediating effects of intrinsic motivation, ease of use and usefulness perceptions on performance in first-time and subsequent computer users. Interacting with Computers, 13(5), 549–580.
Deci, E.L., & Ryan, R.M. (1985). Intrinsic motivation and self-determination in human behavior. New York: Plenum Press.
Dennis, A.R., & Kinney, S.T. (1998). Testing media richness theory in the new media: The effects of cues, feedback, and task equivocality. Information Systems Research, 9(3), 256–274.
Dervin, B., & Nilan, M. (1986). Information needs and uses. Annual Review of Information Science, 21, 3–33.
Douglas, S.P., & Craig, S.C. (1992). Advances in international marketing: A review. International Journal of Research in Marketing, 9, 291–318.
El-Shinnawy, M., & Markus, L.M. (1997). The poverty of media richness theory: Explaining people's choice of electronic mail vs. voice mail. International Journal of Human-Computer Studies, 46(4), 443–467.
Fang, X., Chan, S., Brzezinski, J., & Xu, S. (2005–6). Moderating effects of task type on wireless technology acceptance. Journal of Management Information Systems, 22(3), 123–157.
Ford, M.E. (1992). Motivating humans: Goals, emotions, and personal agency beliefs. Newbury Park, CA: Sage.
Fornell, C., & Larcker, D. (1987). A second generation of multivariate analysis: Classification of methods and implications for marketing research. In M.J. Houston (Ed.), Review of marketing (pp. 407–450). Chicago: American Marketing Association.
Galbraith, J.R. (1973). Designing complex organizations. Reading, MA: Addison-Wesley.
Gefen, D., Karahanna, E., & Straub, D.W. (2003). Trust and TAM in online shopping: An integrated model. MIS Quarterly, 27(1), 51–90.
Hair, J.F., Tatham, R.L., Anderson, R.E., & Black, W. (1998). Multivariate data analysis. Englewood Cliffs, NJ: Prentice-Hall.
Herzberg, F., Mausner, B., & Snyderman, B. (1959). The motivation to work. New York: Wiley.
Hong, S.-J., Tam, K.Y., & Kim, J. (2006). Mobile data service fuels the desire for uniqueness. Communications of the ACM, 49(9), 89–94.
Hsu, C.-L., & Lu, H.-P. (2007). Consumer behavior in online game communities: A motivational factor perspective. Computers in Human Behavior, 23(3), 1642–1659.
Hwang, Y. (2005). Investigating enterprise systems adoption: Uncertainty avoidance, intrinsic motivation, and the technology acceptance model. European Journal of Information Systems, 14(2), 150–161.
Igbaria, M., Iivari, J., & Maragahh, H. (1995). Why do individuals use computer technology? A Finnish case study. Information & Management, 29(5), 227–238.
Igbaria, M., Parasuraman, S., & Baroudi, J.J. (1996). A motivational model of microcomputer usage. Journal of Management Information Systems, 13(1), 127–143.
Karahanna, E., & Limayem, M. (2000). E-mail and v-mail usage: Generalizing across technologies. Journal of Organizational Computing and Electronic Commerce, 10(1), 49–66.
Katerattanakul, P. (2002). Framework of effective web site design for business-to-consumer internet commerce. INFOR, 40(1), 57–69.
King, W.R., & He, J. (2006). A meta-analysis of the technology acceptance model. Information & Management, 43(6), 740–755.
Koufaris, M. (2002). Applying the technology acceptance model of flow theory to online consumer behaviour. Information Systems Research, 13(2), 205–223.
Lee, K.C., Kang, I., & Kim, J.S. (2007). Exploring the user interface of negotiation support systems from the user acceptance perspective. Computers in Human Behavior, 23(1), 220–239.
Lee, M.K.O., Cheung, C.M.K., & Chen, Z. (2005). Acceptance of Internet-based learning medium: The role of extrinsic and intrinsic motivation. Information & Management, 42(8), 1095–1104.
Lee, Y., Kozar, K.A., & Larsen, K.R.T. (2003). The technology acceptance model: Past, present, and future. Communications of the Association for Information Systems, 12, 752–780.
Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. Information & Management, 40(3), 191–204.
Leonard, D.A., Brands, P.A., Edmondson, A., & Fenwick, J. (1998). Virtual teams: Using communications technology to manage geographically dispersed development groups. In S.P. Bradley & R.L. Nolan (Eds.), Sense&respond—Capturing value in the network era (pp. 285–298). Boston, MA: Harvard Business School Press.
Lewis, W., Agarwal, R., & Sambamurthy, V. (2003). Sources of influence on beliefs about information technology use: An empirical study of knowledge workers. MIS Quarterly, 27(4), 657–678.
Li, D., Chau, P.Y.K., & Lou, H. (2005). Understanding individual adoption of instant messaging: An empirical investigation. Journal of the Association for Information Systems, 6(4), 102–129.
Lim, K.H., & Benbasat, I. (2000). The effect of multimedia on perceived equivocality and perceived usefulness of information systems. MIS Quarterly, 24(3), 449–471.
Lin, C.S., Wu, S., & Tsai, R.J. (2005). Integrating perceived playfulness into expectation-confirmation model for web portal context. Information & Management, 42(5), 683–693.
Liu, L., & Ma, Q. (2005). The impact of service level on the acceptance of application service oriented medical records. Information & Management, 42(8), 1121–1135.
Ma, Q., & Liu, L. (2004). The technology acceptance model: A meta-analysis of empirical findings. Journal of Organizational and End User Computing, 16(1), 59–72.
Maslow, A.H. (1962). Toward a psychology of being. New York: Princeton.
Mennecke, B., & Strader, T. (2002). Mobile commerce: Technology, theory, and applications. Hershey, PA: Idea-Group.

DOI: 10.1002/asi

Mennecke, B.E., Valacich, J.S., & Wheeler, B.C. (2000). The effects of media and task on user performance: A test of the task-media fit hypothesis. Group Decision and Negotiation, 9(6), 507–529.
Moon, J.W., & Kim, Y.G. (2001). Extending the TAM for a World-Wide-Web context. Information & Management, 38(4), 217–230.
Ngwenyama, O.K., & Lee, A.S. (1997). Communication richness in electronic mail: Critical social theory and the contextuality of meaning. MIS Quarterly, 21(2), 145–167.
Nokia. (2000). 3G market research: 3G tariffing end user study global findings. Nokia Market Research Center. http://research.nokia.com/
Nysveen, H., Pedersen, P.E., & Thorbjornsen, H. (2005a). Explaining intention to use mobile chat services: Moderating effects of gender. Journal of Consumer Marketing, 22(5), 247–256.
Nysveen, H., Pedersen, P.E., & Thorbjornsen, H. (2005b). Intentions to use mobile services: Antecedents and cross-service comparisons. Journal of the Academy of Marketing Science., 33(3), 330–346.
O'Kane, P., & Hargie, O. (2007). Intentional and unintentional consequences of substituting face-to-face interaction with e-mail: An employee-based perspective. Interacting with Computers, 19(1), 20–31.
Parasuraman, A., & Zinkhan, G.M. (2002). Marketing to and serving customers through the Internet: An overview and research agenda. Journal of the Academy of Marketing Science, 30(4), 286–295.
Reeve, J.M. (1996). Motivating others: Nurturing inner motivational resources. Boston, MA: Allyn & Bacon.
Robert, L.P., & Dennis, A.R. (2005). Paradox of richness: A cognitive model of media choice. IEEE Transactions on Professional Communication, 48(1), 10–21.
Robinson, L., Marshall, G.W., & Stamps, M.B. (2005). Sales force use of technology: Antecedents to technology acceptance. Journal of Business Research, 58(12), 1623–1631.
Secker, M. (2002). MMS: Friend or foe to 3G? Telecommunications International, 36(6), 40–43.
Shannon, C.E., & Weaver, W. (1949). The mathematical theory of communication. Urbana: University of Illinois Press.
Shapira, B., Kantor, P.B., & Melamed, B. (2001). The effect of extrinsic motivation on user behavior in a collaborative information finding system. Journal of the American Society for Information Science and Technology, 52, 879–887.
Short, J., Williams, E., & Christie, B. (1976). The social psychology of telecommunications. London: Wiley.
Sivunen, A., & Valo, M. (2006). Team leaders' technology choice in virtual teams. IEEE Transactions on Professional Communication, 49(1), 57–68.
Sosa, M.E., Eppinger, S.D., Pich, M., McKendrick, D.G., & Stout, S.K. (2002). Factors that influence technical communication in distributed product development: An empirical study in the telecommunications industry. IEEE Transactions on Engineering Management, 49(1), 45–58.
Sun, H., & Zhang, P. (2006). Causal relationships between perceived enjoyment and perceived ease of use: An alternative approach. Journal of the Association for Information Systems, 7(9), 618–645.
Taylor, R.S. (1968). Question-negotiation and information seeking in libraries. College and Research Libraries, 29(May), 178–194.
Telecomworldwide (October 24 2003), MMS usage to generate USD22bn by 2008 claims Strategy Analytics.
Teo, T.S.H., Lim, V.K.G., & Lai, R.Y.C. (1999). Intrinsic and extrinsic motivation in Internet usage. Omega: The International Journal of Management Science, 27(1), 25–37.
Thong, J.Y.L., Hong, S.-J., & Tam, K.Y. (2006). The effects of post-adoption beliefs on the expectation-confirmation model for information technology continuance. International Journal of Human–Computer Studies, 64(9), 799–810.
van der Heijden, H. (2004). User acceptance of hedonic information systems. MIS Quarterly, 28(4), 695–704.
Venkatesh, V. (1999). Creation of favorable user perceptions: Exploring the role of intrinsic motivation. MIS Quarterly, 23(2), 239–260.
Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. Information Systems Research, 11(4), 342–365.
Venkatesh, V., & Davis, F.D. (1996). A model of the antecedents of perceived ease of use: Development and test. Decision Sciences, 27(3), 451–481.
Venkatesh, V., & Davis, F.D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. Management Science, 46(2), 186–204.
Venkatesh, V., Speier, C., & Morris, M.G. (2002). User acceptance enablers in individual decision making about technology: Toward an integrated model. Decision Sciences, 33(2), 297–316.
Webster, J., & Martocchio, J.J. (1992). Microcomputer playfulness: Development of a measure with workplace implications. MIS Quarterly, 16(2), 201–226.
Webster, J., & Trevino, L.K. (1995). Rational and social theories as complementary explanations of communication media choices: Two policy-capturing studies. Academy of Management Journal, 38(6), 1544–1572.
Wold, H. (1985). Partial least squares. In S.K.N.L. Johnson (Ed.), Encyclopedia of statistical sciences (pp. 581–591). New York: Wiley.
Wu, J.-H., Chen, Y.-C., & Lin, L.-M. (2007). Empirical evaluation of the revised end user computing acceptance model. Computers in Human Behavior, 23(1), 162–174.
Yi, M.Y., & Hwang, Y. (2003). Predicting the use of web-based information systems: Self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model. International Journal of Human–Computer Studies, 59(4), 431–449.
Yu, J., Ha, I., Choi, M., & Rho, J. (2005). Extending the TAM for a t-commerce. Information & Management, 42(7), 965–976.

Appendix: Technical Terms

Convergent validity indicates the extent to which the items of a scale that are theoretically related should correlate highly.

Discriminant validity is the extent to which the measure is not a reflection of some other variables.

Composite reliability of a construct is a commonly used measure to check whether the candidate scale items measure the construct in question or other (related) constructs. Composite reliability is calculated as:

Composite Reliability

$$= \frac{\left(\sum Standardized\ Loading\right)^2}{\left(\sum Standardized\ Loading\right)^2 + \sum \in_j}$$

The indicator reliabilities should exceed 0.70 for a construct.

Average variance Extracted reflects the overall amount of variance in the indicators accounted for by the latent construct. The variance extracted measure is calculated as:

Average Variance Extracted

$$= \frac{\sum (Standardized\ Loading^2)}{\sum (Standardized\ Loading^2) + \sum \in_j}$$

The variance extracted value should exceed 0.50 for a construct.

DOI: 10.1002/asi