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Exploring factors affecting Chinese consumers' usage of short message service for personal communication

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Abstract. *Short message service (SMS) is very popular in China. While many reports indicate that the SMS market has great potential, little is known about why people adopt SMS. This study uses the technology acceptance model and network externalities to examine the factors influencing the adoption of SMS for personal communication in China. Using data collected from 262 mobile phone users, we find that perceived usefulness, perceived enjoyment and perceived service cost affect SMS use. Perceived network externalities also contribute to higher perceived usefulness and perceived ease of use and affect SMS adoption. The results provide insight to SMS marketing strategies.*

Keywords: short message service, mobile commerce, technology acceptance model, network externalities

1. INTRODUCTION

Short message service (SMS), the exchange of text messages using mobile devices, is one of the fastest growth areas in the telecommunications industry (Faulkner & Culwin, 2005). With the increasing number of mobile phone users in China, the use of SMS has increased since China Mobile introduced this service in 2001. Recent statistics indicate that the number of mobile phone users in China exceeded 443 million at the end of 2006, and 430 billion short messages were sent during that year (Ministry of Information Industry (MII), 2006).

Three vendors offer SMS in China. They are China Mobile, China Unicom and China Telecom, with the first two having a majority of the market share. Based on statistics released by the MII, we list in Table 1 the numbers of short messages sent each year from 2004 to 2007 (MII, 2008).

In recent years, the number of SMS users has been steadily increasing. According to iResearch (2007), at the end of 2006, there were 400 million SMS users, and the number will

Correction on p. 13, line 38, added on 26 January 2009 after first online publication. 'The composite reliability (CR) was estimated' have been changed to 'We used the composite reliability (CR)'.

Table 1. Numbers of short messages sent each year from 2004 to 2007

	2004	2005	2006	2007
Number of messages (in billion messages)	217.05	304.63	429.54	592.10

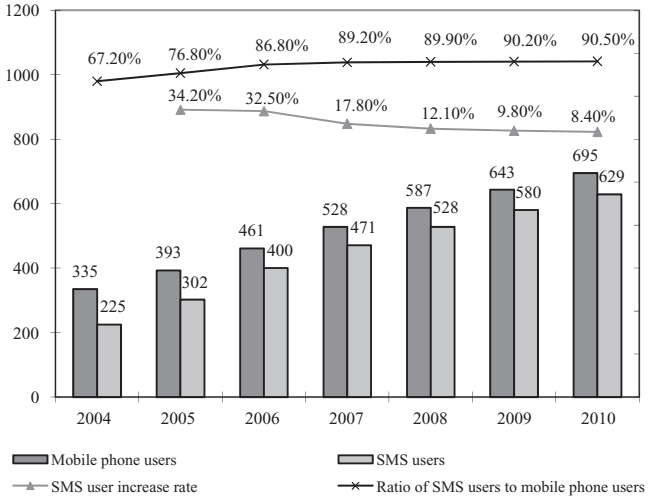

Figure 1. Numbers and forecasts of SMS users from 2004 to 2010.

reach 528 million in 2008. We display the numbers of mobile phone users and SMS users from 2004 to 2006 and the forecasts from 2007 to 2010 in Figure 1.

SMS mainly offers four functions in China. First, it supports individual communication such as chatting, discussion and greetings. In a way, SMS has changed the way Chinese communicate with each other. For example, instead of visiting or calling friends, mobile phone users can now send short greeting messages to each other during traditional Chinese holidays. This is especially the case during the spring festival, even to the extent where people could not send out their messages because of the large message volume and the insufficient bandwidth. During the 2005 Spring Festival, 11 billion text messages were sent, and the numbers went up to 12.6 billion and 15.2 billion in 2006 and 2007, respectively (Xinhua Net, 2007). Second, SMS supports subscription to information and services such as news, weather forecast and stock information. Third, SMS allows interaction such as participation in TV and radio programmes. This service is especially popular among young mobile users. For example, the Super Girl or Super Boy programme on Hunan TV – the Chinese version of the American Idol singing contest – allowed audiences to vote using SMS and choose the winners. Fans of the programmes even urged their friends and families to vote using SMS. Fourth, SMS supports business client communication. For example, software vendors such as Tencent use SMS to deliver user IDs and passwords after user registration. In addition, students can obtain their college entrance exam grades through SMS, which is faster than the traditional method. In this

research, we focus only on the first function, that is, using SMS for personal communication with friends, families and colleagues.

It is important to examine SMS adoption for personal communication for two reasons. First, SMS is an important communication tool for many mobile users and makes up a significant fraction of mobile network operators' revenues. By examining what factors affect mobile users' adoption of SMS, the current research helps mobile network operators in identifying factors they should focus on or improve in order to attract more users. Second, in the mobile business context, SMS is not only important by itself, but also the medium for the delivery of other services such as mobile banking and mobile marketing. Therefore, understanding why consumers use this service and what factors affect their usage behaviours help researchers and practitioners to better understand SMS and other mobile services. In addition, Meso *et al.* (2005) argued that 'more study is needed on how to further m-commerce within developing countries'. Compared with developed countries, the income and penetration rates of new technologies are generally lower in developing countries. As a result, technology adoption in developing countries may be influenced more by economic factors and by the difficulty level of the technology because of limited exposure to new technologies.

In this paper, we examine SMS adoption for personal communication from the user-acceptance perspective using the technology acceptance model (TAM) (Davis, 1989; Davis *et al.*, 1989) and network externalities (Lange *et al.*, 2001). TAM and its derivatives, such as TAM2 (Venkatesh & Davis, 2000) and the Unified Theory of Acceptance and Use of Technology (Venkatesh *et al.*, 2003), have been extensively applied to studies on the adoptions of various technologies such as email (Gefen & Straub, 1997), the World Wide Web (Lederer *et al.*, 2000), Enterprise Resources Planning (ERP) systems (Amoako-Gyampah & Salam, 2004), online shopping (Vijayasarathy, 2004), e-government services (Carter & Bélanger, 2005) and m-commerce (Pagani, 2004; Luarn & Lin, 2005; Wu & Wang, 2005; Yang, 2005; Kim *et al.*, 2007). Researchers have also used TAM to study the adoption of mobile service (Wang *et al.*, 2006). Despite the wide application of TAM, most research is conducted in western countries. As a culture that prefers implicit communication, has a rich history on the use of poetry to express oneself and is dominated by young adopters of innovative technologies, China's SMS adoption may be affected by other factors in addition to those constructs in TAM. In this research, we adapt TAM to fit the Chinese context and reveal some of these additional important factors.

Compared with the Meso *et al.* (2005) study on user adoption of mobile technologies, ours differ in two aspects. First, we examine the actual usage rather than the behavioural intention. According to Benbasat & Zmud (2003), intention is an important construct for information systems research. However, actual system usage is also a key factor in adoption studies (Citrin *et al.*, 2000; Hung *et al.*, 2003), and actual usage is different from behaviour intention (Belk, 1985; Young *et al.*, 1998; Limayem *et al.*, 2001; Kim & Kwahk, 2007). A few studies examine the actual user behaviour rather than the behavioural intention using TAM (Fusilier & Durlabhji, 2005; Yan *et al.*, 2006; Seyal & Rahman, 2007). As we aim to assess mobile phone users' use of SMS, we also use the same approach in this study. Second, there are other factors that may influence SMS usage behaviours. For example, researchers have found that

network externalities strongly influence user adoption of telecommunications tools (Wang *et al.*, 2004) and that perceived enjoyment is an important factor in the adoption of new technologies (Moon & Kim, 2001). We incorporate these important dimensions in our research.

In this research, we examine user acceptance and usage of SMS for personal communication and empirically test whether TAM and network externalities can explain consumers' behaviours. Our research has the following contributions. First, we explore user acceptance of SMS in China, where mobile phone usage is undergoing a process of rapid development. Although previous research has studied the adoption of mobile commerce and mobile services, it primarily focuses on the experiences of consumers in western countries. The adoption of mobile commerce and mobile services in China may be different because of cultural and economic differences. First, the Chinese culture differs from the western one in that it has a strong preference for implicit communication (Gao, 1998a; Bi, 1999). Also, Chinese is a rich language and China has a long history on the use of poetry to express ideas and feelings (Yang, 2008). Second, compared with western countries such as Europe and the United States, mobile phone conversations in China are more expensive relative to income (Xu, 2007), as phone conversations are charged by the minute, and roaming and long distance cost extra. In contrast, SMS has a per message charge and is much cheaper. Third, most adopters of innovative technologies in China are the young generation (China Mobile, 2006; China Internet Network Information Center (CNNIC), 2007a; 2007b). These unique aspects reveal the importance of examining what factors affect SMS adoption in the Chinese context.

Second, we integrate TAM and network externalities in explaining user behaviour. In China, mobile users can easily send text messages to a group of people and many enjoy sharing funny messages they receive with others. As a result, a large population of SMS users may encourage other people to use the SMS technology.

Third, we expand TAM with another new construct, communication effectiveness. This construct is important in SMS adoption, as SMS is a tool mainly used for communication. It has advantages over phone conversations in situations such as during meetings or in noisy environments.

The remainder of this paper is organized as follows. We first discuss the unique aspects of SMS adoption in China in section 2. Next, we review the related literature and present the research model and hypotheses in section 3, followed by the research instrument and sample in section 4. The results are reported in section 5. Finally, we present the conclusions and discuss the implications of the findings in section 6.

2. UNIQUE ASPECTS OF SMS ADOPTION IN CHINA

China has the following unique characteristics in SMS adoption.

First, in China, the main users of mobile phones and SMS are the young generation. Many surveys have suggested that the majority of mobile phone users are between 18 and 35 years old (China Mobile, 2006; CNNIC, 2007b). In addition, young people are the main users of SMS

(Yang, 2005; Wikipedia, 2007). A survey conducted by a university in China indicated that 73.2% of college students were heavy SMS users (China Youth Daily, 2006). This is not specific to mobile phone or SMS adoption, but to technology adoption in China in general. For example, the June 2007 CNNIC survey on Chinese internet users shows that 51.2% of internet users were younger than 25, and 70.6% were younger than 30 (CNNIC, 2007a). In addition, 36.7% were students. Given this unique characteristic, we mainly focus on the young generation in selecting our respondents for the survey.

Second, economic consideration is an important factor affecting SMS adoption and usage. In China, mobile phone calls are charged by the minute and long distance costs extra. On the other hand, sending short messages are much cheaper as there is only a fixed per message fee. As most mobile phone users in China still have limited income, the cost difference presents a major motivation for SMS adoption. According to a survey of Chinese mobile phone users in November 2006, more than 70% used SMS to save on their mobile phone bills (Xia, 2007). This points out the importance of considering economic factors in our theoretical model of SMS adoption in China.

Third, sending short messages in China allows individuals not only to stay connected but also to bring laughter and fun to their friends, families and colleagues. After receiving a hilarious short message or a good greeting message, a mobile user often passes it on to friends and family through SMS. There are even short message contests where authors of funny or nice messages could win prizes. These messages will then be widely circulated among SMS users. Given these considerations, it is important that we also examine 'having fun' as a driver of SMS adoption. In the next section, where we discuss our research model and hypotheses, we introduce a construct called 'perceived enjoyment' that helps us to capture the fun aspect of SMS adoption.

Fourth, as many Chinese prefer more implicit communication (Gu, 1990; Liu *et al.*, 2005), SMS has become a preferred communication medium under certain situations. For example, a national Chinese SMS user survey conducted by Tegic Communications Inc., a developer of text input technology for mobile devices and a subsidiary of America Online, revealed that two-thirds of those surveys used SMS to ask others out (Qingdao News, 2004). According to Ding & Shen (2004), SMS allows users to express their love or apologies that are otherwise difficult in face-to-face conversations. In our research, we add communication effectiveness to our theoretical model and examine how it affects their adoption behaviour of SMS.

Next, we develop our theoretical framework by adapting TAM to take into consideration the above-mentioned unique aspects of SMS adoption in China.

3. RESEARCH MODEL AND HYPOTHESES

3.1 Technology acceptance model

TAM is a theoretical model explaining the relationship between perceived ease of use, perceived usefulness, intention and actual usage. According to Davis (1989), a user's accep-

tance of an information system is determined by the user's intention to use the systems, while perceived usefulness and ease of use can affect the usage intention. Perceived usefulness refers to the degree to which the use of an information system produces desirable outcomes. Perceived ease of use refers to the inherent complexity and difficulty in learning and using the system. TAM states that if a system or service will enhance a person's job performance and using it will be free of effort, it will be considered useful and easy to use. As a result, the person will have a higher intention to use the system or service. In addition, TAM states that perceived ease of use is also a predictor of perceived usefulness.

The operation of SMS is relatively simple. The technique used for entering Chinese into computers and mobile devices is Pinyin, which allows for the spelling of Chinese characters using English letters based on the Chinese pronunciations (Yan *et al.*, 2006). Pinyin is taught in elementary schools and is known by most Chinese younger than 60 years old. When entering a Chinese character, all that a user needs to do is to type in the English letters corresponding to the Chinese character and select the appropriate one from a list of displayed characters with the same pronunciation. New users to SMS, especially those who already know how to enter Chinese into a computer, can learn how to use it very quickly. However, because mobile devices have smaller keyboards, some users may perceive them as being difficult to operate. As a result, users may form their perceived ease of use based on these different considerations, and perceived ease of use may further affect their SMS adoption behaviour.

As one important communication tool, SMS helps users communicate with their friends or colleagues anytime and anywhere. They can feel the care from their friends or relatives and release work stress. In addition, multicasting features allow one user to send a short message to many other SMS users. Therefore, the mobility and ease of use that SMS provides may make users perceive it as being useful.

Age may also affect SMS usage. Because few people over 60 years old learned Pinyin, many do not know how to input Chinese characters via the mobile phone keyboards. As a result, perceived difficulty of use may be more of a barrier to SMS adoption for them. In contrast, as the younger generation learned Pinyin and young people learn new technologies faster, their SMS adoption may be less affected by how easy they perceive SMS to be. Based on the previous discussion, we have:

H_{1a}: Perceived ease of use is positively related to the SMS usage behaviour.

H_{1b}: Perceived ease of use is positively related to perceived usefulness.

H_2: Perceived usefulness is positively related to the SMS usage behaviour.

H_3: Age moderates the effect of perceived ease of use on the SMS usage behaviour.

Researchers have extended TAM to incorporate the influences of technological and usage context factors that may affect user acceptance (Moon & Kim, 2001). Davis *et al.* (1992) viewed enjoyment as an intrinsic motivation towards the use of information systems. Teo *et al.* (1999) examined the impact of enjoyment on consumer usage of internet shopping. They

found that enjoyment had a significant effect on a consumer's attitude. Nysveen *et al.* (2005) showed that perceived enjoyment was stronger for experiential services such as SMS, contact services, payment and gaming services. Höflich & Rössler (2001) claimed that enjoyment was a significant factor influencing user adoption of mobile services. In China, people often indulge in sending and receiving short messages to communicate feelings, thoughts and perspectives. As a result, we extend TAM by adding perceived enjoyment to our explanation of user acceptance of SMS. As we discussed in section 2, SMS is especially popular among young people in China. And they often indulge themselves in it to obtain a fun experience. In contrast, older people usually use SMS only to conduct business. This suggests age as a possible moderator on the impact perceived enjoyment has over actual usage.

H_4: Perceived enjoyment is positively related to SMS usage.

H_5: Age moderates the effect of perceived enjoyment on the SMS usage behaviour.

3.2 Perceived network externalities

Katz & Shapiro (1986) developed the concept of network externalities to explain the large-scale adoption of new technologies. Network externalities refer to the phenomenon where the value of joining a network increases with the number of members in the network (Economides, 1996; Kauffman *et al.*, 2000). Examples of technologies that exhibit network externalities are telephones and email. Network effects arise if more users adopt a technology, resulting in a higher value for the technology and motivating additional adoption.

Researchers have applied network externalities on the adoption of technologies, including spreadsheet software (Brynjolfsson & Kemerer, 1996), video cassette recorder (Ohashi, 2003), information technology goods (Gallaugher & Wang, 1999b), technology products (Pae & Hyun, 2002) and Web servers (Gallaugher & Wang, 1999a). Wang *et al.* (2004) used network externalities to examine user adoption of internet instant messaging services. Strader *et al.* (2007) studied the effect of perceived network externalities on the adoption of communication technology such as email and instant messaging. Their findings suggested that network externalities had an important influence on adoption. In this research, we study an individual's perceived network externalities. As the number of SMS users increases, potential adopters can send text messages to more people and may perceive the technology as more useful and valuable, which will encourage adoption. In addition, as the number of SMS users increases, more existing users may teach new adopters how to use the system and existing users may exchange information and tips on how to use SMS (Lou *et al.*, 2001), which may lead to higher perceived ease of use and more frequent use of SMS.

H_{6a}: Perceived network externalities are positively related to perceived ease of use.

H_{6b}: Perceived network externalities are positively related to perceived usefulness.

H_{6c}: Perceived network externalities are positively related to the SMS usage behaviour.

3.3 Communication effectiveness

One of the unique characteristics of the Chinese culture is that people often engage in indirect communication (Bi, 1999). This is because of the importance of 'face' or 'image' in the Chinese culture, where people carefully cultivate each other's image and try to maintain harmonious relationships (Ho, 1976). To give others face or to save one's own face, Chinese use communication strategies such as implicit communication, listening-centredness, politeness, a focus on insiders and face-directed communication (Gao, 1998b). When examining why SMS became very popular among Chinese, especially the young generation, Ding & Shen (2004) pointed out that SMS was well suited for the Chinese culture. Specifically, they argued that: (1) SMS fitted well with the implicit and low-key characteristics of the Chinese culture. By sending text messages instead of speaking loudly in public, SMS is more polite and gives the message recipient more response time; (2) SMS allowed people to take advantage of the rich Chinese language and send more precise and concise messages; and (3) compared with phone conversations, SMS was more indirect and allows one to save face in situations such as expressing love or making apologies. Given these unique aspects of Chinese communication practices and their fit with SMS, people may perceive that it is more appropriate to communicate with SMS. We consider this important communication effectiveness construct next and develop the related hypotheses.

Farace *et al*. (1978) defined communication effectiveness as 'the degree to which the response to a message transmission event is consonant with the overall objectives of the initiator of the event'. Previous research has examined the impact of communication effectiveness on the quality of ERP system implemented (Wang & Chen, 2006) and individuals' attitude towards websites (Geissler *et al.*, 2006; Long & Chiagouris, 2006). In our research, considering the unique Chinese culture, we define communication effectiveness as, compared with other alternatives, the extent to which SMS helps people to communicate effectively with others and provides implicit and private communication. In the mobile context, SMS is widely used in China as a communication tool complimentary to other communication methods such as face-to-face interaction or phone conversation because of its versatility in noisy environments, during meetings and on the way to and from work (Yan *et al.*, 2006). Many Chinese also prefer using implicit communication, for example, in the style of Tang or Song dynasty poetry and other interesting Chinese words, to express themselves when the time comes to express their love or apologies (Ding & Shen, 2004; Xue, 2007). Thus, when using SMS, individuals are able to more politely express themselves in a euphemistic way. In addition, with the wide coverage of mobile networks (Zhao, 2006; Shen, 2008), text messages can be sent and received anytime and almost anywhere at low costs. When people use SMS to communicate, ubiquitous mobility is an important consideration. For example, Lee (2005) empirically showed that it had a significant effect on users' behaviour intention. So when users enjoy higher communication effectiveness, it may lead to a higher probability of using SMS. Therefore, we propose:

H_{7a}: Perceived communication effectiveness is positively related to perceived usefulness.

H_{7b}: Perceived communication effectiveness is positively related to the SMS usage behaviour.

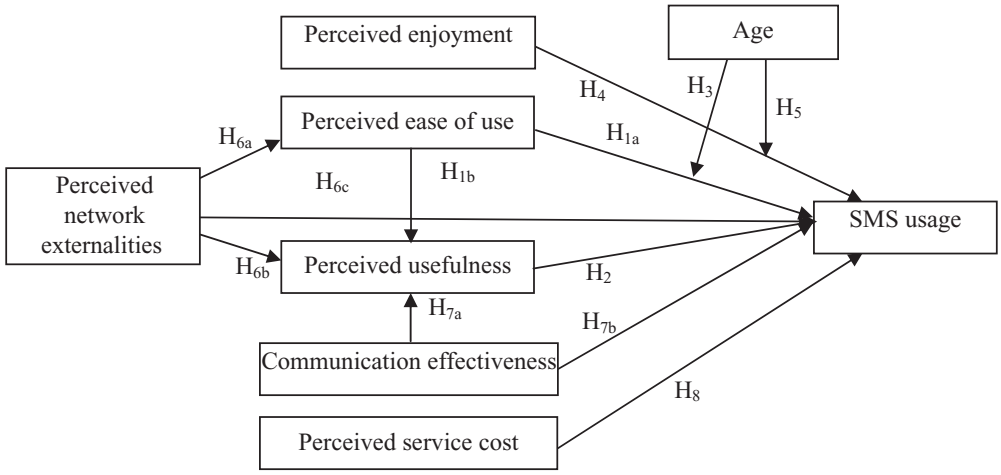

Figure 2. The research model.

3.4 Perceived service cost

In China, SMS is very popular especially among young people. One main reason relates to the affordability for low or no-income student groups. For example, a China Mobile mobile phone user pays 0.1 yuan to send a text massage within the China Mobile network and 0.15 yuan for a message to other networks. Receiving messages is free. Costs for mobile phone calls are much higher. In Wuhan, a major city in eastern China, it costs somewhere between 0.10 to 0.30 yuan per minute for mobile phone conversations with others in the same city. Long distance charges are extra and usually exceed 1 yuan. Thus, users can send more text messages at the same cost of a one-minute mobile phone call. Based on the fact that economic motivations and outcomes are important considerations in information system acceptance (Mathieson *et al.*, 2001; Bunduchi, 2005) and that perceived cost was found to be a significant antecedent to actual usage of mobile commerce (Pagani, 2004; Wu & Wang, 2005), we hypothesize:

H_8: Perceived service cost is negatively related to the SMS usage behaviour.

We summarize our research model and hypotheses on user acceptance of SMS in China in Figure 2.

4. RESEARCH METHOD

4.1 Instrument development and pre-test

We used a questionnaire survey to collect data on mobile phone users' perceptions and adoptions of SMS. We mostly adapted scales used in previous studies to ensure content

validity. Specifically, items measuring perceived usefulness and ease of use were adapted from Davis (1989); items measuring perceived enjoyment were adapted from Moon & Kim (2001); perceived network externalities were measured by three items adapted from Wang *et al.* (2004) and three items we developed ourselves; items measuring perceived service cost were adapted from Wu & Wang (2005); and items of actual usage were adapted from Davis (1989). We developed the scales measuring SMS communication effectiveness. When examining the use of multimedia for web-based negotiation, Yuan *et al.* (2003) measured communication effectiveness using three items including expression power, memorability and comfort. In our research, given the preference for implicit communication in the Chinese culture and our definition of communication effectiveness, our items for communication effectiveness reflected two relevant dimensions including expression power and comfort. The adapted items were modified to fit the context of SMS we examined. Seven-point Likert scales, with anchors ranging from 'strongly disagree' to 'strongly agree', were used for all questions, except the items measuring actual usage where we used the frequency and the volume of SMS usage.

Except the scales that we developed ourselves, the other items were translated into Chinese by one researcher and the Chinese version of the questionnaire was back translated into English by another researcher. Then we compared the two English versions and made minor revisions to the Chinese questionnaire to ensure that we preserved the meanings of all items. This step was conducted to ensure the translation accuracy of the survey instrument (Chung, 1997; Birbili, 2000; Chen & Tjosvold, 2005). We summarize our constructs, their operational definitions, the numbers of items used to measure the constructs and the sources of the scales in Table 2. A pre-test of these measures was conducted through selected users who used SMS frequently. We revised the ambiguous questions based on their feedback. Furthermore, we conducted face-to-face interviews with two professors in the e-commerce research area and two practitioners. One practitioner was the CEO of mobile service provider Beijing Mayroy Telecommunication Technology Co. Ltd., and the other was a senior manager at mobile network operator China Telecom's Hubei branch. During these interviews, we explained our research to them and asked them to provide feedback on whether the questions were relevant for the m-business context and if we had omitted any important aspects. Based on the feedback from scholars and practitioners, we further revised the questionnaire. We list the scales used in Appendix A.

4.2 Data collection procedure

We study the communication function of SMS in this research. Data used to test our research model were collected from a sample of respondents through the client service departments of China Mobile and China Unicom – the two largest mobile network operators in China, and two MBA classes in Wuhan and Zhengzhou – two large cities in eastern and central China, respectively. We also sent questionnaires to undergraduate students in a national university in Wuhan. We sent out 400 questionnaires and received 262 completed surveys. Among the survey respondents, we had 34 MBA students in Wuhan, 35 MBA students in Zhengzhou, 20 China Mobile users, 30 China Unicom users and 143 undergraduate students.

Table 2. Research constructs and measurements

Construct	Operational definition	Number of measurement items	Source
Actual SMS usage	The actual SMS usage behaviour including the number of monthly short messages sent and the frequency of SMS use	2	Moon & Kim (2001)
Perceived usefulness	An individual's perception of improved performance when she uses SMS	5	Davis (1989)
Perceived ease of use	An individual's perception of efforts exerted when using SMS	4	Davis (1989)
Perceived enjoyment	The degree to which an individual perceives using SMS as enjoyable, aside from performance outcomes related to the use of SMS	5	Moon & Kim (2001)
Perceived network externalities	The degree to which an individual feels others are using SMS	6	Three items from Wang *et al.* (2004); three self-developed items
Communication effectiveness	Compared with other alternatives, the extent to which SMS helps a user to communicate effectively with others and provides implicit and private communication	5	Self-developed items
Perceived service cost	The costs or fees an individual perceives when using SMS	3	Wu & Wang (2005)

4.3 Sample

Table 3 lists the descriptive statistics of our sample. A majority of our sample (84.7%) was between the ages of 18 and 30, as most of our respondents were undergraduates and MBA students. Recent surveys of mobile phone users revealed that most were between 18 and 35 years old (China Mobile, 2006; Anonymous, 2007). In addition, young people are the main users of SMS or mobile applications (Yang, 2005; Wikipedia, 2007). A survey conducted by a university in China indicated that 73.2% of college students were heavy SMS users (China Youth Daily, 2006). As a result, though our sample was relatively young, they represented the major segment of the mobile phone user market, who were the current or perspective SMS users.

The majority of the respondents had college education. A total of 133 (50.8%) of the respondents were male and 129 (49.2%) were female. Most of the respondents' monthly income was below 3000 yuan. This also corresponds well to the fact that more than 70% of the mobile phone users in China had monthly income less than 3000 yuan (Third Media, 2006). About half of the respondents (125) had used SMS for more than 3 years, thus they were familiar with the operation of SMS and other services provided by service providers. Most of the respondents (152) subscribed to China Mobile and ten of them had two or three mobile phones.

Table 3. Sample descriptive statistics

Variable	Count	Percentage (%)
Gender		
Male	133	50.8
Female	129	49.2
Age (years)		
<18	0	0.0
18–24	161	61.4
25–30	61	23.3
31–35	28	10.7
36–40	6	2.3
>40	6	2.3
Education		
High school	6	2.3
Associate degree	32	12.2
Bachelor's degree	133	50.8
Master's degree or above	91	34.7
Monthly income (yuan)		
<1000	153	58.4
1000–2000	37	14.1
2000–3000	36	13.7
3000–4000	19	7.3
>4000	17	6.5
Years using SMS		
<1	24	9.2
1–2	47	17.9
2–3	66	25.2
3 or more	125	47.7
Service providers		
China Mobile	152	58.0
China Unicom	71	27.1
China Telecom	62	23.7

In order to test the difference among the groups, we conducted one-way analysis of variance (ANOVA) to compare the means of the same construct among college students, MBA students and subjects through the client service departments of China Mobile and China Unicom. Apart from the actual SMS usage ($F(2, 259) = 5.129$, $p = 0.007$) and perceived service cost ($F(2, 259) = 13.748$, $p = 0.000$), no other significant differences were found among the three groups. Follow-up pair-wise comparisons based on Tukey tests revealed that college students had significantly more SMS usage than MBA students and the clients of the two mobile network operators. Compared with college students, the last two groups had higher income and their perceived service cost was less. So they might perceive sending messages as more inconvenient than phone conversations, thus their actual usage of SMS was less. In contrast, college students perceived the service costs as more expensive than the other two groups.

The main reason was that students had no or low income. As a result, we perceive no problem in pooling the data from the three groups for the testing of our research model.

We conducted ANOVA tests and *t*-tests on user groups with different SMS usage experiences, ages and genders. We found no significant difference on the constructs among the four groups with different usage experiences. However, the results indicated respondents in different age groups differed significantly on their perceived ease of use, perceived network externalities and perceived service cost. Specifically, the older the user, the lower the perceived ease of use, perceived network externalities and perceived service cost. The results of the independent sample *t*-tests showed that, except perceived ease of use, there were no significant difference for the means of constructs between female and male at the 0.05 level.

5. RESULTS

5.1 Measurement model testing results

We first used a principal components factor analysis to examine the factorial validity of the scales based on the methods Hair *et al.* (1998) proposed. The Kaiser-Meyer-Olkin statistic was 0.832 and it was higher than the 0.5 level Kaiser (1974) recommended. Thus, our data were acceptable. We present the results of the rotated component matrix using varimax with Kaiser normalization in Appendix B. There were seven factors, extracting 62.945% of the variance. Each of the items loaded highly on its related single factor (>0.5) and had low cross-loadings (<0.5), indicating good validities. Even though some items had relatively high cross-loadings, such cross-loadings were all smaller than the recommended value of 0.5 (Hair *et al.*, 1998). Furthermore, the reliability of the constructs did not improve when we dropped these items, so we decided to keep them in our data analysis.

Because the data of the constructs were collected from the selected users, common method variance (CMV) could exist. In order to test the significance of the CMV, we conducted Harman's one-factor test (Harman, 1967; Podsakoff *et al.*, 2003). At the same time, we performed a factor analysis. The results indicate that the explained variance of each factor is smaller than 20%. Thus the CMV is not a problem in our study.

We used structural equation modelling to test our proposed model. We first tested the distribution of our data and summarized the descriptive statistics of each scale, including the maximum, minimum, mean, standard deviation, skewness and kurtosis in Appendix C. For each item, the skewness was less than 2 and the kurtosis was less than 5, so we could view each item as having a normal distribution (Curran *et al.*, 1996). The scales were then tested for reliability and validity using the confirmatory factor analysis, which allowed us to test the measurement model before testing the structural model. The model included 29 items describing seven latent constructs: perceived usefulness (PU), perceived ease of use (PEOU), perceived enjoyment (PE), perceived service cost (PSC), perceived network externalities (PNE), communication effectiveness (CE) and actual usage (AU).

We used the composite reliability (CR) to evaluate the internal consistency of the measurement model. All of the CRs and Cronbach's alphas were over 0.8, indicating the

Table 4. Item loadings on related factors and *t*-values

Factor	Item	Standard loading	*t*-Value	AVE	CR	Cronbach's alpha
Actual usage	AU1	0.79	10.39	0.73	0.84	0.831
	AU2	0.91	18.36			
Perceived usefulness	PU1	0.79	11.98	0.54	0.86	0.853
	PU2	0.82	13.74			
	PU3	0.74	12.24			
	PU4	0.64	10.45			
	PU5	0.68	11.11			
Perceived ease of use	PEOU1	0.83	11.24	0.61	0.866	0.858
	PEOU2	0.71	12.32			
	PEOU3	0.72	12.51			
	PEOU4	0.85	15.21			
Perceived enjoyment	PE1	0.78	14.25	0.50	0.83	0.833
	PE2	0.75	13.57			
	PE3	0.61	10.29			
	PE4	0.68	11.83			
	PE5	0.71	12.51			
Perceived network externalities	PNE1	0.78	14.48	0.53	0.87	0.873
	PNE2	0.73	13.34			
	PNE3	0.7	12.48			
	PNE4	0.79	14.87			
	PNE5	0.67	11.87			
	PNE6	0.71	12.72			
Perceived service cost	PSC1	0.92	18.34	0.73	0.89	0.887
	PSC2	0.87	17.05			
	PSC3	0.77	14.21			
Communication effectiveness	CE1	0.83	16.03	0.62	0.89	0.886
	CE2	0.81	15.26			
	CE3	0.77	14.27			
	CE4	0.72	12.84			
	CE5	0.81	14.40			

scales had good reliabilities (Nunnally, 1978; Bagozzi & Yi, 1998). (See Table 4) We also present the completely standardized factor loadings in Table 4. The majority of the standard loadings were over 0.70 and all were significant at the 0.001 level. The scales had good convergent validities as the average variance extracted (AVE) for every construct was over 0.5 (Fornell & Larcker, 1981).

We also tested for the discriminant validity by comparing the square root of the AVE of each factor and the correlation coefficients with other factors. The square root of the AVE was larger than the corresponding correlation coefficients with the factors, suggesting good discriminant validity. (See Table 5)

Table 5. Correlation coefficient matrix and square roots of AVEs (shown as diagonal elements)

	Mean	SD	AU	PU	PEOU	PE	PNE	FE	CE
Actual usage	5.05	1.454	**0.852**						
Perceived usefulness	5.25	0.859	0.52	**0.737**					
Perceived ease of use	5.17	0.998	0.42	0.64	**0.780**				
Perceived enjoyment	4.71	0.985	0.44	0.50	0.56	**0.708**			
Perceived network externalities	5.36	0.873	0.39	0.40	0.42	0.59	**0.731**		
Perceived service cost	3.797	1.651	0.05	0.13	0.13	0.37	0.18	**0.857**	
Communication effectiveness	5.01	1.158	0.36	0.48	0.47	0.68	0.66	0.30	**0.789**

Table 6. Fit indices of CFA and recommended values

Fit index	χ^2/df	RMSEA	GFI	AGFI	CFI	NFI	NNFI	IFI
Recommended value	<3	<0.08	>0.90	>0.80	>0.90	>0.90	>0.9	>0.90
Model value	2.23	0.067	0.82	0.80	0.97	0.95	0.97	0.97

CFA, confirmatory factor analysis; RMSEA, root mean square error of approximation; GFI, goodness of fit index; AGFI, adjusted goodness of fit index; CFI, comparative fit index; NFI, normed fit index; NNFI, non-normed fit index; IFI, incremental fit index.

The measurement model testing showed there was a good fit between the data and the proposed measurement model. We used the chi-square/degrees of freedom because of the inherent difficulty with the sample size. The χ^2/df value was 2.23, which fell into the less than three range that Joreskog & Sorbom (1993) recommended. We show the various goodness of fit statistics in Table 6. The root mean square error of approximation was in the recommended range of acceptability (<0.08) suggested by MacCallum *et al.* (1996). The comparative fit index, normed fit index, non-normed fit index and incremental fit index are greater than the recommended values (>0.90). Although the goodness of fit index (GFI) is slightly lower than the recommended value (>0.90), it is close to the recommended threshold. While we can artificially increase the GFI to 0.90 by dropping items, we decided not to do it to preserve content validity. Overall, because the other model fit indices fell into the recommended ranges, we consider the model fits the data well.

5.2 Structural model testing results

To test the significance of each hypothesized path in the research model, we used LISREL and report the results in Figure 3. Of the 10 main hypothesized paths, eight were significant at the 0.05 level. The percentages of variance in perceived usefulness, perceived ease of use and actual usage explained were 38, 31 and 28%, respectively. The effect of perceived ease of use on actual usage was not significant and communication effectiveness did not have a significant influence on perceived usefulness.

In this model, perceived ease of use and perceived usefulness are two mediators. We test their mediating effects based on the method developed by Baron & Kenney (1986). According

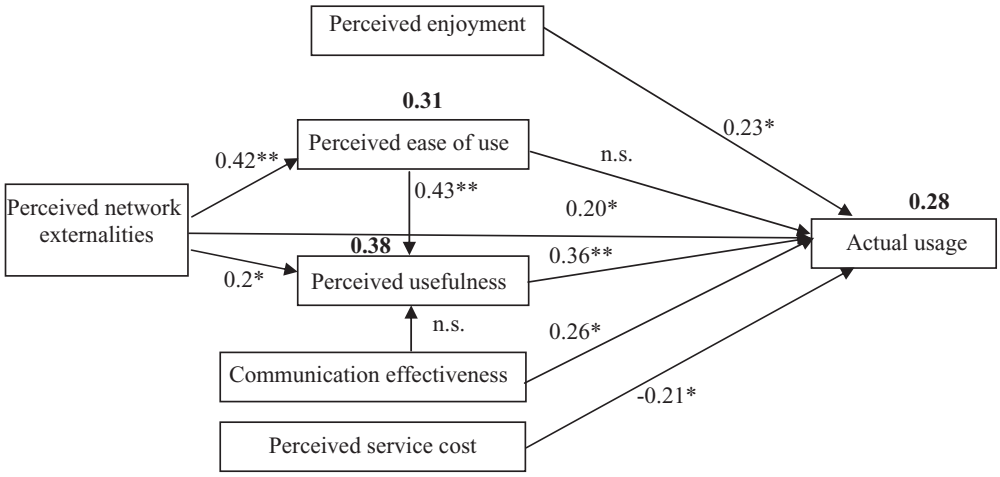

Figure 3. Hypothesis testing results (*$p < 0.05$; **$p < 0.01$; n.s., non-significant).

Table 7. Mediation effects of perceived ease of use and perceived usefulness

					IV+M→DV	
IV	M	DV	IV→DV	IV→M	IV	M
Perceived network externalities	Perceived ease of use	Perceived usefulness	0.529**	0.597**	0.294**	0.393**
Perceived network externalities	Perceived ease of use	Actual usage	0.438**	0.597**	0.324**	0.190**
Perceived network externalities	Perceived usefulness	Actual usage	0.438**	0.529**	0.293**	0.273**
Perceived ease of use	Perceived usefulness	Actual usage	0.384**	0.569**	0.107	0.311**

**$p \leq 0.01$.

IV, independent variable; M, mediator; DV, dependent variable.

to them, mediating effects should satisfy the following three conditions: (1) when we regress the dependent variable on the independent variable, the coefficient should be significant; (2) when we regress the mediator on the independent variable, the coefficient should be significant; and (3) when we regress the dependent variable on the mediator and the independent variable, the coefficient of the mediator should be significant. If the coefficient of the independent variable in (3) is smaller than that in (1), then there is partial mediation; if the coefficient of the independent variable in (3) is insignificant, then there is full mediation. We summarize our mediating effect testing results in Table 7. Perceived ease of use partially mediates the effects of perceived network externalities on perceived usefulness and actual usage; perceived usefulness partially mediates the effect of perceived network externalities on actual usage, and fully mediates the effect of perceived ease of use on actual usage.

We tested the moderating effect using the method Chin *et al.* (2003) developed. As perceived ease of use had an insignificant effect on actual usage, we need not test the moderating

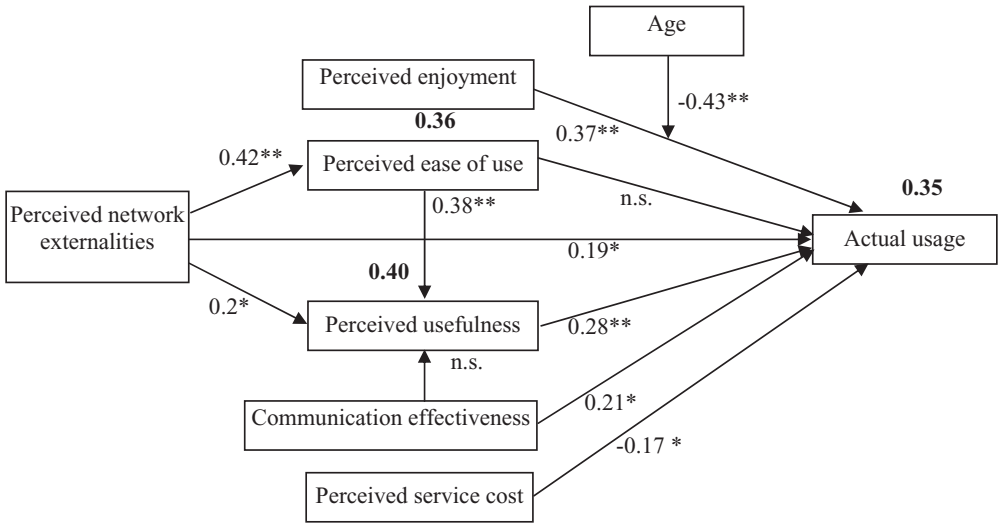

Figure 4. Testing results on age's moderating effects (*$p < 0.05$; **$p < 0.01$; n.s., non-significant).

effect of age on the link between them. The results are shown in Figure 4. Age had a negative moderating effect on the relationship between perceived enjoyment and actual usage and the explained variance in actual usage increased from 28 to 35%. This result suggests the impact of perceived enjoyment on actual usage was stronger for young SMS users.

6. DISCUSSION AND CONCLUSIONS

In this research, we examine factors affecting SMS adoption for personal communication in China. Our hypothesis testing provides support for all the hypotheses except H_{1a}, H_3, and H_{7a}. The factors significantly influencing actual usage were perceived usefulness, communication effectiveness, perceived enjoyment, perceived service cost and perceived network externalities. Figure 3 shows that among these factors, perceived usefulness had the most significant effect. Age has a negative moderating effect on the relationship between perceived enjoyment and actual usage. And if we consider this moderating effect, perceived enjoyment had the most significant effect on actual usage.

We find that perceived enjoyment had a positive effect on actual usage. This result corroborates findings from previous research. When users find a technology to be interesting and fun, they will form positive attitudes such as happiness, excitement and satisfaction towards the technology, which will, in turn, lead to more usage. The moderating effect of age indicates that perceived enjoyment has a stronger impact on actual usage for young SMS users than older ones.

Perceived network externalities had a significant impact on perceived ease of use, perceived usefulness and actual usage. The path coefficients were 0.42, 0.20, and 0.20, respectively. As the number of SMS users increases, there is a larger network to send text messages to. In addition, SMS providers are also more motivated to add additional value added services and keep improving existing ones. All of these factors will lead to higher usefulness and ease of use, which will encourage additional usage.

We also confirmed the impact of perceived ease of use on perceived usefulness. If users perceive SMS as being difficult to use, they will consider it less useful and switch to other alternatives for their communication needs.

Communication effectiveness is a new construct we introduced in our research and it had a significant impact on actual usage. When users perceive SMS as an effective communication medium, they will use it more often in place of other communication alternatives.

Perceived service costs had a negative impact on actual usage. When users perceive SMS as being expensive, they will use it less.

Our finding shows that perceived ease of use had an insignificant effect on usage. This finding corroborates the results of Koufaris (2002), who pointed out that perceived ease of use was not a significant factor affecting e-commerce adoption. Moreover, prior research also revealed the perceived ease of use was a significant factor influencing adoption intention in the pre-implementation stage when users had little or no experience with a system, but its effect diminished as users became more familiar with the system (Venkatesh & Davis, 1996; Venkatesh, 2000). In our study, as we examine continued adoption and users had experience with SMS already, it is no surprise that we do not find its impact on usage behaviour significant. The effect of communication effectiveness on perceived usefulness is not significant either. One possible explanation is that SMS users view effective communication as the basic requirement for any type of communication tool and do not differentiate the usefulness of these tools based on their effectiveness.

Firms such as telecommunications companies and service providers that support mobile services are eager to know what factors affect user adoption and how users think about mobile services. Our research results show that mobile network operators should advertise the benefits, fun and low costs associated with using SMS when marketing their services. In addition, they can also emphasize the number of existing SMS users so that potential adopters realize the network effects there which will lead to higher perceived usefulness. When targeting young potential SMS users, companies should especially focus on the fun that SMS brings. Our results also reveal that higher perceived communication effectiveness leads to more usage. Because SMS users can more politely and accurately express themselves using poetry or humorous greetings, mobile network operators can promote such short messages to encourage user adoption. For example, they can post such short messages on their websites so that SMS users can download and send to friends or relatives. They can also organize short message contexts so that more such massages can be created and circulated. Our research results also have implications for mobile network operators for their future product development and service improvement. For example, mobile network operators should focus on customers' perceived usefulness when developing new products or services. In addition, they

should enhance the fun aspect of their new products and services by using vibrant colours, lovely images and enjoyable contents. When pricing new products or services, they should consider consumers' buying power and provide services that can satisfy the needs of consumers at every income level.

Our research has the following three limitations. First, our sample is mainly composed of college and MBA students, although we also had respondents from the client service departments of China Mobile and China Unicom. As a result, we do not have a representative sample of Chinese mobile phone users. Future research may use the random sampling technique to draw SMS users as subjects. However, young adults, especially young students, without a doubt, constitute the majority of SMS users in China. Therefore, we believe our results can still provide insight on SMS adoption in China. Second, the explained variance of actual usage is only 35%. This shows that other factors excluded in the model also affected SMS usage. Future studies can examine how other factors may affect SMS adoption. Third, for SMS users with short vs. long experiences, the factors affecting their usage behaviour may be different. To test this effect, we split our sample into two groups of users with long (three years or more) vs. short experience (less than three years) and test if the impacts of the constructs were the same. Our results showed that for users with short experience, perceived network externalities had insignificant effect on actual usage, and perceived enjoyment significantly affected actual usage; for users with long experience, perceived network externalities significantly affected actual usage, but perceived enjoyment had no significant effect on actual usage. However, because of the smaller sample sizes for the short and long experience groups (139 and 123, respectively), we lose significance on the other model variables. The results nonetheless suggest the differential impacts of the factors depending on usage experience. Future research can examine this in greater detail with larger sample sizes.

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APPENDIX A: SCALES AND ITEMS

Perceived ease of use (PEOU) (adapted from Davis, 1989)
PEOU1: Learning to operate mobile phone messages is easy for me.
PEOU2: It is easy for me to become skillful at using SMS.
PEOU3: I find it easy to get SMS to do what I want it to do.
PEOU4: I think using SMS is easy.

Perceived usefulness (PU) (adapted from Davis, 1989)
PU1: SMS is very useful.
PU2: SMS allows me to conveniently and quickly communicate with others.
PU3: SMS improves the efficiency of my communication with others.
PU4: SMS allows me to understand more information about the world and others.
PU5: I think SMS is indispensable in my life.

Perceived enjoyment (PE) (adapted from Moon & Kim, 2001)
PE1: Using SMS brings much pleasure to me.
PE2: I like sending and receiving interesting greeting and humorous short messages.
PE3: Using SMS makes life fun.
PE4: Using SMS makes me feel happy and relaxed.
PE5: Using SMS is exciting.

Perceived network externalities (PNE)
PNE1: From my observations, the number of SMS users is large. (Adapted from Wang *et al.*, 2004).
PNE2: Many of my friends and relatives frequently use SMS. (Adapted from Wang *et al.*, 2004).
PNE3: I have many opportunities to use SMS.
PNE4: In my opinion, many mobile phone users frequently use SMS. (Adapted from Wang *et al.*, 2004).
PNE5: There are various types of SMS.
PNE6: In my opinion, as a communication tool, SMS is as common as other ways of communication (e.g., face-to-face and phone conversation).

Communication effectiveness (CE)
CE1: I like using SMS to communicate information.
CE2: I feel using SMS I can express myself more implicitly.
CE3: Using SMS allows me to have a variety of ways to communicate with others.
CE4: I don't like making my communication exposed (through voice) when other people are present.
CE5: SMS can be used anytime and anywhere for convenient communication.

Perceived Service Cost (PSC) (adapted from Wu & Wang, 2005)
PSC1: I think the equipment cost of using SMS is expensive.
PSC2: I think the access cost of using SMS is expensive.
PFC3: I think the transaction fee of using SMS is expensive.

Actual SMS usage (AU) (adapted from Moon & Kim, 2001)
AU1: How many short messages do you send during a month?

1	2	3	4	5	6	7
0~50	51~100	101~150	151~200	201~250	251~300	More than 300

AU2: How frequently do you use the SMS?

1	2	3	4	5	6	7
Extremely infrequent	Quite infrequent	Slightly infrequent	Not sure	Slightly frequent	Quite frequent	Extremely frequent

APPENDIX B: ROTATED COMPONENT MATRIX

	Component						
	1	2	3	4	5	6	7
AU1	0.222	0.155	0.087	0.131	–0.073	0.130	**0.852**
AU2	0.171	0.101	0.266	0.121	–0.067	0.166	**0.830**
PU1	0.196	0.131	**0.643**	0.347	–0.095	0.066	0.299
PU2	0.169	0.165	**0.778**	0.206	0.038	0.064	0.150
PU3	0.102	0.098	**0.801**	0.187	0.056	0.155	0.068
PU4	0.144	0.090	**0.763**	–0.002	0.098	0.307	–0.023
PU5	0.431	0.151	**0.507**	0.303	–0.004	–0.060	0.153
PEOU1	0.307	0.088	0.210	**0.767**	0.009	0.078	0.178
PEOU2	0.095	0.143	0.245	**0.732**	0.016	0.209	0.097
PEOU3	0.205	0.284	0.240	**0.619**	0.034	0.290	–0.040
PEOU4	0.399	0.097	0.091	**0.755**	0.062	0.165	0.089
PE1	0.428	0.199	0.094	0.295	0.073	**0.568**	0.076
PE2	0.350	0.217	0.102	0.263	0.211	**0.578**	0.017
PE3	0.017	0.225	0.164	0.237	0.039	**0.718**	0.121
PE4	0.206	0.192	0.179	0.042	0.218	**0.683**	0.179
PE5	0.241	0.162	0.191	0.140	0.224	**0.557**	0.092
PNE1	**0.732**	0.207	0.085	0.191	–0.043	0.234	0.020
PNE2	**0.673**	0.139	0.237	0.120	0.038	0.244	0.086
PNE3	**0.610**	0.247	0.228	–0.003	–0.056	0.311	0.162
PNE4	**0.753**	0.210	0.087	0.164	0.171	0.120	0.158
PNE5	**0.657**	0.212	0.156	0.264	0.023	–0.009	0.073
PNE6	**0.693**	0.247	0.075	0.217	0.078	0.037	0.136
PSC1	0.084	0.095	–0.004	–0.044	**0.920**	0.089	–0.021
PSC2	0.001	0.093	0.057	0.041	**0.887**	0.171	–0.054
PSC3	0.068	0.144	0.038	0.068	**0.838**	0.069	–0.049
CE1	0.164	**0.762**	0.206	0.092	0.173	0.226	0.077
CE2	0.287	**0.741**	0.158	0.120	0.103	0.160	–0.042
CE3	0.175	**0.729**	0.247	0.045	0.092	0.227	0.065
CE4	0.236	**0.759**	–0.008	0.124	0.027	0.109	0.129
CE5	0.254	**0.767**	0.024	0.199	0.121	0.077	0.141
Eigenvalues	4.319	3.576	3.150	2.915	2.629	2.599	1.830
% of variance	14.398	11.920	10.500	9.715	8.764	8.663	6.010
Cumulative	14.398	26.318	36.818	46.533	55.297	63.960	69.970

APPENDIX C: ITEM DESCRIPTIVE STATISTICS

Scale	*n*	Minimum	Maximum	Mean	Standard deviation	Skewness	Kurtosis
AUC1	262	1	7	4.55	1.917	–0.059	–1.222
AUC2	262	1	7	4.96	1.543	–0.503	–0.304
PU1	262	1	7	5.53	1.224	–1.475	2.768
PU2	262	1	7	5.10	1.272	–0.904	0.897
PU3	262	1	7	4.81	1.248	–0.480	0.202
PU4	262	1	7	4.76	1.235	–0.459	0.242
PU5	262	1	7	5.80	1.203	–1.449	2.440
PEOU1	262	1	7	5.74	1.374	–1.329	1.452
PEOU2	262	1	7	4.73	1.101	–0.254	0.776
PEOU3	262	1	7	4.89	1.170	–0.486	0.204
PEOU4	262	1	7	5.69	1.271	–1.193	1.451
PE1	262	1	7	5.27	1.259	–0.930	0.994
PE2	262	1	7	5.13	1.314	–0.484	–0.197
PE3	262	1	7	4.52	1.355	–0.233	–0.381
PE4	262	1	7	4.48	1.295	–0.438	–0.066
PE5	262	1	7	4.90	1.257	–0.541	0.125
PNE1	262	1	7	5.59	1.333	–0.983	0.375
PNE2	262	1	7	5.10	1.355	–0.526	–0.413
PNE3	262	1	7	4.98	1.433	–0.516	–0.473
PNE4	262	1	7	5.37	1.271	–0.641	0.047
PNE5	262	1	7	5.16	1.281	–0.637	0.073
PNE6	262	1	7	5.35	1.177	–0.888	0.818
PSC1	262	1	7	4.34	1.758	–0.428	–0.782
PSC2	262	1	7	3.98	1.760	–0.209	–0.892
PSC3	262	1	7	4.53	1.632	–0.468	–0.491
CE1	262	1	7	5.01	1.384	–0.713	0.489
CE2	262	1	7	5.27	1.324	–0.868	0.667
CE3	262	1	7	4.80	1.455	–0.629	–0.001
CE4	262	1	7	5.36	1.379	–0.807	0.445
CE5	262	1	7	5.47	1.327	–1.068	0.999

