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ORIGINAL ARTICLE

The moderation effects of mobile technology advancement and system barrier on m-commerce channel preference behavior

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Abstract Mobile commerce, or m-commerce, has quickly become a powerful, indispensable approach for diverse business to consumer (B2C) industries to secure technology-oriented, risk-taking N-generation customers. However, their behavioral preferences have not been investigated in-depth, as most practitioners believe m-commerce consumers are merely a frontier group of e-commerce consumers, and not unique service consumers with distinct characteristics. This study examines m-commerce consumers' unique behavioral aspects by conducting thorough theoretical research based on an integrated framework that includes the IS success, web satisfaction, and B2C channel preference models. We first construct an integrated model to analyze the fundamental roles of information system quality in an m-commerce context. A set of hypotheses are then tested and studied to verify the moderation effects of ubiquity, localization, personalization (mobile attributes), and cognitive effort (system barriers) on the newly established relationships. The statistical results are obtained using a survey data of 503 consumers with m-commerce service experiences in Korea, a leading m-commerce country. Finally, the results are analyzed and interpreted to identify m-commerce consumers' perceived service quality levels, as well as their comparative differences against e-commerce consumers. We believe that both researchers and practitioners will benefit from this research, in that it not only isolates a prioritized list of key determinants of m-commerce success, but also highlights the necessity of continuous research effort regarding future market orientations.

Keywords M-commerce · E-commerce · Information quality · System quality · Channel preference · Behavioral intention

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1 Introduction

The complementary relationship between advanced wireless technologies and electronic commerce (e-commerce) service has evolved beyond the generic question of whether it truly improves consumers' lives. This has not only allowed consumers to experience abundant life conveniences in retrieving information, but has also significantly increased society's expectations of overall service experience. Studies of this phenomenon are essential, as the growth of Korea's e-commerce industry reported a 48.6 trillion won revenue with 19.5% growth, compared to nationally renowned supermarkets, with reported revenue of 44.3 trillion won with 2.3% growth from the previous year (Bae 2016).

While a myriad of studies have now examined the causal relationships between mobile attributes and consumers' behavioral intentions, few have assessed the interactions between the principal components of information systems (i.e., information and system quality), mobile attributes (i.e., ubiquity, localization, and personalization), and behavioral intentions (i.e., channel preferences). Karanasios and Allen (2014) emphasized the need to develop insights regarding the consequences of technology's institutionalization, rather than highlight the factors that lead to technology acceptance. Therefore, the investigation of how and where mobile attributes impact existing quality-satisfaction-behavioral intention models will enable both researchers and service providers to better understand what truly drives consumers' use of mobile commerce (m-commerce) services. Hence, our study highlights the following research questions: (1) what are information system quality's fundamental roles in an m-commerce context?; and (2) what are the moderating effects of localization, personalization, ubiquity, and cognitive efforts on the m-commerce service experience?

We integrate previous findings of how the value of mobile attributes affects information system attitudes, with specific regard to the theoretical foundation of the information systems (IS) success (DeLone and McLean 2003) and web satisfaction (McKinney et al. 2002) models. Moreover, we extend the IS success model based on our additional exploration of perceived values (Parasuraman et al. 2005) and commerce channel preferences (Devaraj et al. 2002).

The remainder of the study is organized as follows: The following section provides theoretical backgrounds for information system quality, mobile technology attributes, and system barriers. We then detail the development of our hypotheses and research methodologies. Our analysis and discussion focus on the moderating roles of mobile technology attributes and system barriers in the mobile success model. The paper concludes with detailed discussions for appropriate and effective guidelines, as well as future research directions.

2 Theoretical background

This work observed two separate research efforts in advanced mobile technology's role in electronic commerce (e-commerce) services. First, abundant research has examined business to consumer (B2C) e-commerce success and acceptance models, based on existing or integrative theoretical foundations, including the following

models: IS success (DeLone and McLean 2003), the diffusion of innovation (Kleijnen et al. 2007), technology acceptance (Kim et al. 2010, 2013), service quality—satisfaction (Kuo et al. 2009; Yeh and Li 2009), e-satisfaction (Pereira et al. 2016), and e-service quality (Jiang et al. 2016). Similarly, a second set of studies identified and validated mobile-enabled attributes derived from channel features, such as convenience, compatibility, design/attractiveness (Cao et al. 2005; Wu and Wang 2005; Cyr et al. 2006; Kleijnen et al. 2007), and qualities of information, systems, service, and interaction (Devaraj et al. 2002; Cao et al. 2005; Kuo et al. 2009). However, as Middleton et al. (2014, p. 503) noted, "the expectations of mobile access to information were not as deeply embedded in organizational and personal routines and practices as they are today." Therefore, a need exists to more parsimoniously expose the relationships between quality and satisfaction dimensions by integrating numerous mobile technology attributes.

2.1 Information system quality, satisfaction, and channel preferences in m-commerce

Conventional e-commerce service providers' roles assume: the reliability of an information provider, producing information relevant to customers' needs or interests (information quality); a system provider, operating commerce sites and back-end computer-based systems (system quality); and a service provider for customer service and support (service quality) (Ding et al. 2011). However, these fundamental roles, based upon DeLone and McLean's (2003) IS success model, do not differ among distinct settings, even including mobile channels. McKinney et al. (2002) identified salient dimensions to construct second-order information and system quality factors, known as the web satisfaction model, to more accurately understand channel characteristics and their distinct effects on consumers' satisfaction.

The intention-behavior relationship as proposed by Bagozzi (1992) complements the IS success model in that it assumes that high information systems quality is critical to success, which consequently affects consumers' satisfaction and behavioral decisions. Moreover, Lee et al. (2007) explained that mobile Internet technologies are voluntarily used based on individuals' needs and expectations. Therefore, understanding the antecedents of individual preference is critical to encouraging the repeated use of mobile technologies. For example, channel preference is a *conative* construct, defined as a specific consumer's behavior choice based on his or her prior service experiences (Devaraj et al. 2002). Similar measurements of consumer intention have also been developed, including behavioral intention (Udo et al. 2010), engagement and use (Zhao et al. 2012), purchase intention (Wang and Li 2012; Agudo-Peregrina et al. 2014; Kwahk and Kim 2016), and adoption intentions (Chong et al. 2012), in addition to actual service use (Tojib and Tsarenko 2012), loyalty (Swaid and Wigand 2009), and customer trust (Yeh and Li 2009). Behavioral perspective not only helps researchers and practitioners understand how human attitudes are formed towards certain information technologies, but can also verify and validate the drivers of consumers' mobile channel preferences.

2.2 Mobile technology attributes

M-commerce, namely, advanced information technologies that deliver purchasing experiences to consumers, is surrounded by characteristics distinct from existing, well-known e-commerce domains (Dholakia and Dholakia 2004); we refer to these characteristics as "mobile technology attributes." While previously discovered mobile-enabled characteristics (Clarke III 2001; Kim et al. 2010; Ozok and Wei 2010) provide ample evidence that measures distinct attributes in m-commerce's effectiveness over traditional e-commerce channels, a comprehensive analysis of these constructs is still lacking in the m-commerce domain.

It is critical to understand the context of m-commerce service usability prior to creating new business frameworks or developing innovative strategies (Wang and Li 2012). A related study by Clarke III (2001) defined emerging value propositions for m-commerce based on mobile devices' primary advantages in offering "value-for-time" to users, including ubiquity (i.e., omnipresence), localization, personalization, and convenience. Similarly, Junglas and Watson (2003) defined mobile quality constructs based on how mobility (versus fixation) enables certain distinct benefits compared to existing e-commerce settings, such as reachability, accessibility, localization, and identification. Kim et al. (2010) framed system characteristics in the context of mobile payments (m-payments), such as mobility, reachability, compatibility, and convenience. However, comprehensive empirical analyses are lacking that investigate m-commerce success. Table 1 compares key mobile attributes with those from existing references.

While many studies have attempted to identify the determinants of m-commerce success, few have examined whether m-commerce could potentially serve as a viable alternative to e-commerce, rather than remaining merely complimentary. For example, Ozok and Wei (2010) posited that m-commerce's success depends on how well service providers integrate users' preferences and usability, potentially proving m-commerce as a feasible alternative channel. However, their study concluded that m-commerce should not be seen as a direct competitor to e-commerce, but a complementary medium. This generates several compelling questions, as extensive research has verified mobile-distinct attributes' effectiveness and added value as a standalone e-commerce channel medium.

3 Research hypotheses

Our study aimed to provide compelling empirical evidence built upon a theoretical foundation, which indicates: (1) how information and system quality play critical roles in providing a satisfactory experience and value from m-commerce channels; (2) how mobile technology attributes enable the delivery of value-added commerce experiences; and (3) how mobile system barriers negatively affect consumers' further interest in system use.

Table 1 Examples of key m-commerce attribute (*EC* e-commerce, *MC* m-commerce)

Literature	Mobile attributes			Behavioral intention	Context
This research paper	Ubiquity	Localization	Personalization	Channel preference	MC
Clarke III (2001)	Ubiquity	Localization	Personalization	–	MC
Childers et al. (2001)	–	–	–	Attitude	EC
Junglas and Watson (2003)	Ubiquity	Uniqueness (localization)	–	–	EC
Figge (2004)	–	Position profile	Personal profile	–	MC
Dholakia and Dholakia (2004)	–	Geographic position	Flexible configuration	–	MC
Kleijnen et al. (2007)	–	–	User control	Intention to use	MC
Garofalakis et al. (2007)	–	Purchasing (localization)	Purchasing (personalization)	–	MC
Choi et al. (2008)	Availability	–	–	M-loyalty	MC
Swaid and Wigand (2009)	–	–	Personalization	Preference loyalty	EC
Yeh and Li (2009)	Interactivity	–	Customization	Customer trust	MC
Kim et al. (2010)	Mobility	–	–	Intention to use	MC
Ding et al. (2011)	–	–	–	–	EC
Zhang et al. (2011)	–	–	Personalized recommendation	Store loyalty	EC
Ho (2012)	–	Location-based service	–	Intention to use	MC
Tojib and Tsarenko (2012)	Ubiquity	–	–	Actual service use	MC
Wang and Li (2012)	Usability	Identifiability	Personalization	Purchase intention	MC
Kim et al. (2015)	Mobility	–	Personalization	Usage	MC

3.1 An extension of the information systems success model

Web satisfaction is derived from two distinct sources—content quality and system performance—and is expected to provide a superior understanding of how different channels and their characteristics define an individual consumer's experience (McKinney et al. 2002). We posit that this premise is also applicable to the m-commerce context, specifically regarding the separation of content from content-delivery systems. Moreover, Zhao et al. (2012) noted that a specific system's interaction quality positively influences consumer satisfaction. Analogously, Yeh and Li (2009) examined how the quality of vendors' sites, including interactivity and customization, impacted customer satisfaction; Wang and Liao (2007) similarly verified the positive effects of content quality and appearance on m-commerce users' satisfaction. Based on these posited relationships, we hypothesized that:

H1 Information quality positively affects consumers' satisfaction with m-commerce use.

H2 System quality positively affects consumers' satisfaction with m-commerce use.

Eggert and Ulaga (2002) proposed that consumer satisfaction alone does not provide adequate managerial insight into how to appropriately respond to consumers' needs and wants. Consumers may not consciously know the exact meaning of mobile system quality regarding any specific system, while nevertheless believing that they gain specific benefits and usefulness from using a service (Lee 2014). Among studies in the mobile domain, Kuo and Yen (2009) discovered that overall service quality positively influences the perceived values of mobile value-added services. Based on these inferred relationships, we hypothesized that:

H3 Information quality in m-commerce use is positively associated with its perceived value.

H4 System quality in m-commerce use is positively associated with its perceived value.

Similarly, perceived value significantly contributes to satisfaction, in addition to quality performance. Perceived value in marketing has been considered a key to corporate success and competitive advantage (Kuo et al. 2009). This has also been used as a basis for a mobile user engagement model to identify perceived value as the precedent cognitive factor of consumer satisfaction (Kim et al. 2013). Consequently, both perceived value and satisfaction should be collectively examined (Eggert and Ulaga 2002; Kim et al. 2013). It is especially crucial in high technology environments to understand whether mobile value-added experiences' perceived benefits can truly enhance the overall satisfaction with its use (Yang et al. 2004). Based on these perceived correlations, we hypothesized that:

H5 Perceived value positively affects consumers' satisfaction with m-commerce use.

We aimed in the current endeavor to understand how consumers form preferences based on their overall experiences, and how this influences their evaluation of a service. Previous studies regarding perceived value's effects on post-purchasing behavior have included such variables as loyalty (Yoo and Donthu 2001; Parasuraman et al. 2005; Bauer et al. 2006), word of mouth communication (Wang and Liao 2007; Swaid and Wigand 2009), subsequent intentions or actual behavior (Lam et al. 2004; Tojib and Tsarenko 2012), and post-purchase attitudes (Kuo et al. 2009). Based on these previously reported findings, we hypothesized that:

H6 Perceived value positively affects consumers' preferences for commerce activity channels.

Many researchers have proposed and validated a positive relationship between satisfaction and behavioral intentions, such as loyalty, a post-purchase mindset, engagement intention, continued intention, and channel preference (Bhattacherjee 2001; Devaraj et al. 2002; DeLone and McLean 2003; Kuo et al. 2009; Kim et al. 2013). Such satisfaction levels should affect the post-experience decisions to reuse or recommend the service to others. Based on these purported relationships, we hypothesized that:

H7 Satisfaction positively affects consumers' preferences for commerce activity channels.

3.2 Moderating roles of mobile technology attributes and system barriers

Personalization refers to the delivery of personalized content or services based on individual users' real-time, actual location, using an altered display and sound to inform consumers of these specific offerings (Clarke III 2001). This concept approximates the offering of tailored products or services based on consumers' needs and preferences (Mulvenna et al. 2000; Nunes and Kambil 2001; Mahatanankoon et al. 2005; Jahng et al. 2007; Ho 2012). Personalization was previously known to only indirectly affect loyalty (Ball et al. 2006); Anckar and D'Incau (2002) indicated that personalized services should not be a value proposition, but a prerequisite for m-commerce, based on the nature of that specific channel. Notably, Zhang et al. (2011) elaborated that information personalization's strategic value to consumer shopping behavior becomes meaningful only when the overall service quality is perceived to exceed a self-defined standard. However, the value of personalization has become accentuated within an m-commerce context, attributed to its sole characteristic of representing a private, personal handheld device that enables one-on-one marketing (Wang and Li 2012), such as sending tailored promotional messages to individuals' mobile devices, among other unique offerings (Ho 2012). Consequently, we aimed to clarify and confirm that tailoring products and services through mobile technology can greatly improve consumers' satisfaction with, and how they value their m-commerce experiences. We tested the following related hypotheses:

H8 A highly perceived personalization attribute will strengthen the positive relationship between **(a)** information quality and satisfaction, and **(b)** information quality and perceived value.

Localization refers to a service provider's capability to identify users' geographical locations through the use of GPS technologies and other available location-based services (Clarke III 2001). Localization, like ubiquity, is generally noted as a feature more distinctive to m-commerce than traditional e-commerce (Junglas and Watson 2003). Previous journals merely infer how GPS technology might provide location-specific information useful for m-commerce. However, Wang and Li (2012) provided concrete examples of how mobile payment service systems, such as paying for transportation and receiving time-sensitive notifications regarding air flight schedule changes, are distinct advantages of m-commerce. Therefore, GPS technology not only accurately identifies specific consumers' geographical locations, but it can also allow service providers to connect consumers to their geographically closest selling points (Garofalakis et al. 2007). The impacts of this localization feature suggest effective identifiability based on environmental quality (Lu et al. 2009), perceived quality, brand awareness and association (Wang and Li 2012), and context of use (Constantiou et al. 2014). Thus, our study endeavored to explore how localization's advantages might effectively contribute to consumers' satisfaction and the value of m-commerce services. These conjectures constituted the following tested hypotheses:

H9 A highly perceived localization attribute will strengthen the positive relationship between **(a)** information quality and satisfaction, and **(b)** information quality and perceived value.

Ubiquity, or omnipresence, refers to consumers' accessibility and interactivity with mobile devices, including financial transactions, unrestricted by time and location (Clarke III 2001). Consumers must proactively initiate the use of services for wired device technologies and non-handheld, Wi-Fi-operated devices, such as laptops. However, mobile technologies allow users to permanently stay online and remain connected to their desired service providers (Junglas and Watson 2003). Hence, ubiquity is commonly acknowledged as a merit exclusive to the mobile medium (Tojib and Tsarenko 2012). However, mixed messages remain, in that ubiquity is not the sole determinant of m-commerce success (Figge 2004; Ozok and Wei 2010). Tojib and Tsarenko (2012) discovered that service ubiquity's supporting role is futile if the consumer's motivations (i.e., enjoyment, ease of use, and convenience) and affective sentiments (experiential value and satisfaction) are not in place. However, a lack of clear visibility exists regarding whether ubiquity can replace or complement the aforementioned antecedents of consumers' m-commerce experiences. Additionally, mobile service users could already have higher expectations for ubiquity benefits (Junglas and Watson 2003), as ubiquity is characteristically considered a vital advantage of m-commerce compared to e-commerce applications (Schierz et al. 2010). Therefore, further studies are necessary to better understand ubiquity's specific supporting role(s) within behavioral models. Thus, this study aimed to elaborate whether ubiquity could potentially

strengthen consumers' continued engagement in mobile channels. The resulting tested hypotheses include the following:

H10 A highly perceived ubiquity attribute strengthens the positive relationship between **(c)** satisfaction and channel preference, and **(d)** perceived value and channel preference.

Cognitive effort refers to the mental expenditure for information acquisition, which significantly increases in highly complex technology environments (Kleijnen et al. 2007). Innovation comes at a cost, contributing to the uncertainty of consumers who may or may not be willing or able to afford the services, or may conclude that the expense is not worth the time and effort of mastering the complexity of using such technologies. This relationship naturally emerges from mobile devices' inherent attributes versus conventionally wired device settings (Kleijnen et al. 2007). Further, any effort that requires users to proactively initiate and learn creates an access barrier. Cronin et al. (1997) discovered that excessive mental effort contributes to perceived overall cost, arising from the adage that "time equals money." Kim et al. (2007) further noted that time, search effort, convenience, and psychological costs are collectively included as noneconomic barriers to use. Moreover, information search costs caused by mobile data consumption are similarly viewed as value barriers (Kleijnen et al. 2007). As activities that require minimal effort increase their likelihood of engagement (Davis 1989), our study aimed to explore how cognitive effort negatively affects the preference for m-commerce channels. This motivation clarified whether perceived cognitive effort diminishes m-commerce experiences' overall satisfaction and value, and conclusively tested our following hypotheses:

H11 A highly perceived cognitive effort will attenuate the positive relationship between **(c)** satisfaction and channel preference, and **(d)** perceived value and channel preference.

4 Research methodology, analysis, and results

We tested the eleven hypotheses of interest by designing a survey according to the integrated (Fig. 1) and moderated (Fig. 2) models. As Fig. 1 illustrates, an integrated model including IS success, perceived value, and channel preference models consists of the relationships between the indicators (squares) and the latent constructs (circles), to examine their relative importance in determining consumers' channel preference. Both information and system quality constructs are operationalized as second-order constructs, which are directly measured by indicating variables for the first-order constructs. For example, the second-order information quality construct was directly measured by the indicators for the first-order constructs' relevance, understandability, reliability, adequacy, and usefulness. Information and system qualities were operationalized as second-order constructs not necessarily because their indicating variables are highly correlated, but because they change second-order constructs individually. Moreover, by modeling

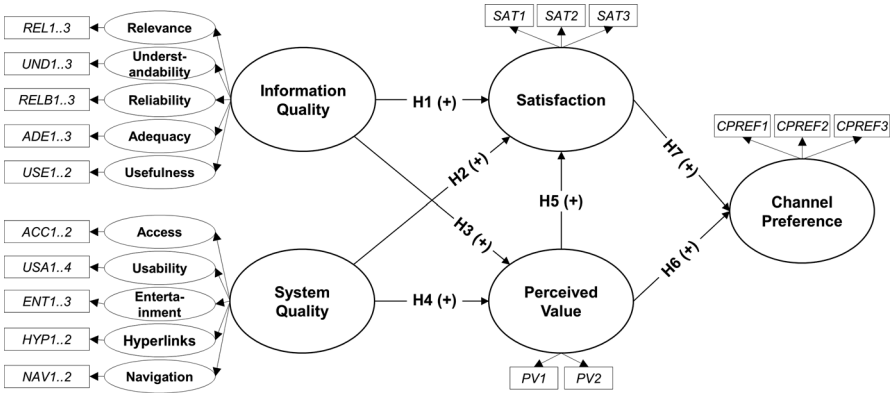

Fig. 1 Integrated model of IS success, perceived value, and channel preference

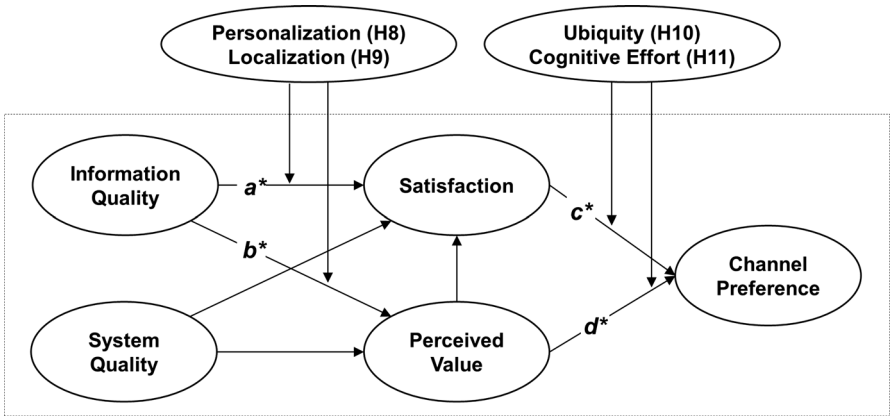

Fig. 2 M-commerce technology attributes and system barrier moderated model

information and system qualities as second-order constructs, the study can build a parsimonious model to examine first-order variables' comprehensive effects on channel preference (Chiu et al. 2014). Perceived value, satisfaction, and channel preferences are operationalized as first-order constructs, measured by the eight indicating variables.

The moderated model in Fig. 2 consists of first-order constructs—personalization, localization, ubiquity, and cognitive efforts—and the models' integration using dotted lines. The hypothesized moderating relationship is illustrated as follows: a^* = Hypotheses 8a and 9a; b^* = Hypotheses 8b and 9b; c^* = Hypotheses 10c and 11c; and d^* = Hypotheses 10d and 11d. We only verify this subset of eight tested hypotheses for brevity in this study, although we initially conducted 28 complete tests of the hypotheses regarding moderation effects (Appendix 2).

4.1 Data collection and descriptive statistics

We selected nationally renowned, online-only shopping sites (e.g., Gmarket, 11st, Auction, and Interpark) to both verify the scales' adapted psychometric properties and test interrelationships. This consideration was important, as our study's sampling frame necessitated that individuals experience conventional e-commerce and m-commerce, rather than offline versus online sites. We tested our hypotheses by consulting a nationwide surveying organization according to three steps: (1) the listing of survey respondents, (2) screening, and (3) conducting the survey. First, a cross-sectioned list of over 1300 South Korean residents with m-commerce experiences was produced at random. A filtering process was conducted in the second step by determining whether specific persons had sufficient knowledge of using m-commerce purchasing webpages or applications (i.e., who had completed $\geq$1 mobile transactions within the previous 12 months). Unbiased respondents were retained here, such as those with no financial conflicts of interest or personal contacts at merchant companies, among others. After the screening process, we obtained a usable, stratified sample size of 503 respondents (37.6% response rate) who conducted a complete online survey at the third step. The questionnaire was based on measures well established by assessment studies (Appendix 1), and was also translated into Korean by a professional language instructor to ensure consistent wording in the questionnaires.

Table 2 displays the subjects' characteristics. The sample was almost equally divided between males and females, with 51.9% shopping via mobile channels at least once a month; the subjects' ages followed a uniform distribution from, 20 to 60.

4.2 Reliability and validity analyses

The measurement models in this section were tested to confirm their consistency with empirical data. The structural equation model was then applied using AMOS

Table 2 Study respondents' demographics (n = 503)

Characteristics	Items	Frequency	Percentage
Gender	Male	244	48.5
	Female	259	51.5
Age	20–29	113	22.5
	30–39	124	24.7
	40–49	128	25.4
	50–59	138	27.4
Shopping frequency	Once a week	191	38.0
	Once a month	261	51.9
	Once a year	51	10.1
Average purchase price *(assumed 1000 KRW = 1 USD)*	<$50	276	54.9
	$50–$100	194	38.6
	$100–$200	28	5.6
	$200+	5	1.0

21.0 to test the hypotheses against the proposed research model. Appendix 1 indicates that all Cronbach's alpha values were greater than 0.7; thus, the assessment was reliable (Nunnally and Bernstein 1967). The model demonstrated acceptable fit indexes: $\chi^2 = 1085.55$, $df = 574$, $p < 0.000$, Normed Fit Index (NFI) = 0.916, Tucker–Lewis Index (TLI) = 0.954, Comparative Fit Index (CFI) = 0.958, and Root-Mean Squared Error of Approximation (RMSEA) = 0.042. We further assessed both discriminant and convergent validities through a confirmatory factor analysis (CFA) using a maximum likelihood estimation, regarding the nomological validity verified through a correlation matrix analysis of the constructs. Table 3 notes the primary constructs' descriptive statistics, and the correlation matrix is displayed in Table 4.

Convergent validity was assessed based on each construct's standardized loadings (Table 3). Standardized loadings ranged from 0.77 to 0.94, were significant at $p < 0.01$, and the average variance extracted (AVE) values for each construct ranged from 0.66 to 0.71. As all exceeded 0.50, the constructs' convergent validity was supported (Fornell and Larcker 1981). Each squared multiple correlation (SMC) value, a test coefficient of communality, ranged from 0.62 to 0.88 and considerably satisfied a cutoff value of 0.50 (Fornell and Larcker 1981). Construct

Table 3 Results of confirmatory factor and construct validity analyses

Measurement items	Standardized loading	SMC	Mean (SD)	Cronbach's α	CR	AVE
Information quality			3.39 (0.22)	0.94	0.93	0.71
Relevance	0.79	0.62				
Understandability	0.80	0.65				
Reliability	0.81	0.66				
Adequacy	0.94	0.88				
Usefulness	0.88	0.77				
System quality			3.18 (0.18)	0.95	0.82	0.70
Access	0.91	0.82				
Usability	0.88	0.78				
Entertainment	0.77	0.59				
Hyperlinks	0.79	0.63				
Navigation	0.87	0.75				
Perceived value			3.65 (0.73)	0.82	0.85	0.66
PV1	0.83	0.69				
PV2	0.84	0.70				
Satisfaction			3.40 (0.79)	0.85	0.87	0.69
SAT1	0.79	0.62				
SAT2	0.83	0.69				
SAT3	0.82	0.68				
Channel preference			3.35 (0.90)	0.87	0.93	0.71
CPREF1	0.81	0.68				
CPREF2	0.81	0.62				
CPREF3	0.86	0.71				

Table 4 Construct correlations and discriminant validity

Constructs	IQ	SQ	PV	SAT	CPREF
Information quality (IQ)	0.84				
System quality (SQ)	0.81	0.84			
Perceived value (PV)	0.55	0.60	0.83		
Satisfaction (SAT)	0.59	0.67	0.68	0.83	
Channel preference (CPREF)	0.48	0.56	0.64	0.89	0.84

reliabilities (CR) ranged from 0.82 to 0.93, substantially exceeding the recommended value of 0.70 (Gefen 2000), therefore validating the constructs' unidimensionality. The latent constructs' reliabilities (i.e., Cronbach's α values) ranged from 0.82 to 0.95, in accordance with Nunnally's (1967) suggestion that each construct score should be greater than 0.60 to be considered reliable.

Discriminant validity was assessed by examining whether the AVEs' square roots (noted as the variables on the diagonal in Table 4) were greater than the inter-construct correlation coefficients (Fornell and Larcker 1981). All correlations satisfied this condition, with the exception of the correlation with satisfaction and channel preferences. A Chi square discriminant validity test of the satisfaction and channel preference constructs revealed these were significantly distinct ($p < 0.001$). Additionally, a CFA with two separate constructs ($\chi^2 = 45.25$, $df = 8$, $p < 0.001$, NFI = 0.98, RMESA = 0.15, and CFI = 0.98) had a better fit index than a CFA with two combined constructs ($\chi^2 = 104.87$, $df = 9$, $p < 0.001$, NFI = 0.95, RMSEA = 0.09, and CFI = 0.95). This implies that the two constructs should be distinctively assessed.

4.3 Integrated model results (H1–H7)

As Table 5 indicates, Hypotheses H2–5 and H7 were supported, while Hypotheses H1 and H6 were not supported. This is based on the standard errors (SE) and critical ratios (CR), with an acceptable fit index for the structural model: $\chi^2 = 1227.89$, $df = 647$, $N = 503$, $p < 0.000$, NFI = 0.91, TLI = 0.951, CFI = 0.955, and RMSEA = 0.042.

Namely, system quality directly and positively affected both satisfaction ($\beta = 0.38$, $p < 0.001$) and perceived value ($\beta = 0.46$, $p < 0.001$). However, information quality only significantly affected perceived value ($\beta = 0.29$, $p < 0.05$), and not satisfaction. We further observed that perceived value significantly and directly affected satisfaction, but fully and satisfactorily mediated channel preference ($\beta = 0.45$, $p = 0.004$) as determined by bootstrapping.

4.4 Moderating effects model results (H8–H11)

Each attribute was then divided into "high" and "low" groups to the investigate moderating roles of mobile technology attributes and system barriers in accordance with Baron and Kenny's (1986, p. 1175) notation that "the levels of the moderator are treated as different groups" (Dabholkar and Bagozzi 2002). Our study's "low"

Table 5 Results of hypothesized research models

Hypotheses		Loadings	SE	CR	Sig.	Result
H1	Information quality → Satisfaction	0.07	0.12	0.55	0.583	Not supported
H2	System quality → Satisfaction	0.38	0.09	4.33	0.001	Supported
H3	Information quality → Perceived value	0.29	0.14	2.06	0.039	Supported
H4	System quality → Perceived value	0.46	0.10	4.83	0.001	Supported
H5	Perceived value → Satisfaction	0.46	0.06	7.77	0.001	Supported
H6	Perceived value → Channel preference	0.09	0.07	1.37	0.172	Not supported
H7	Satisfaction → Channel preference	0.98	0.08	13.10	0.001	Supported

Table 6 Factor mean comparisons for the two low and high groups examined

Constructs	Mean split (SD)	Number of respondents for examined groups		
		Low group	High group	Total
Personalization	3.25 (0.49)	212	291	503
Localization	3.66 (0.45)	362	141	503
Ubiquity	4.04 (0.47)	335	168	503
Cognitive effort	2.80 (0.50)	226	277	503

and "high" groups were formed based on the mean splits of the consumers' evaluations (Table 6). Subsequently, the core integrated model for each moderating variable was tested for low and high groups, to research and confirm into mobile technology attributes' moderating effects on a subset of Hypotheses H1–H7.

Dabholkar and Bagozzi's (2002) two-step analysis was adapted to examine potential moderating variables and verify that changes between the low and high groups were due to true group differences, versus measurement errors. This two-step analysis method conducts χ^2 difference tests using four different models to distinguish the effects by coefficients from the effects by differences in the error variances. Four different models are as follows: Model A has all factor loadings and error variances of the items for endogenous variables constrained across the groups. Model B has the factor loadings free, but error variances constrained. Model C has both factor loadings and error variances free, and Model D has factor loadings constrained, but error variances free.

The first test compared Models A–D, and Models B–C. Any significant differences in the Chi square value indicated that the difference between two groups was caused by error variances in the dependent variables. Models A and D, and Models B and C, were essentially identical except for ubiquity ($\Delta\chi^2 = 17.70$, $\Delta df = 3$, $p = 0.001$). In other words, the difference between two groups regarding the ubiquity construct is likely caused by error variances instead of true group differences.

The second test compared Models A and B. Any significant differences in the Chi square values indicated that the differences between the two groups arose from the factor loadings, implying significant moderating effects across the low and high groups (Im et al. 2011). Table 7 displays the overall acceptable fit indexes, based on

Table 7 Structural equation results for moderating effect models

Constructs	Model	χ^2	*df*	GFI	NFI	CFI	RMR	RMSEA	$\triangle\chi^2/\triangle df$	Sig.
Default model		1227.89	647	0.88	0.91	0.96	0.03	0.04		
Moderating variables										
Personalization	A	2123.09	1309	0.82	0.83	0.93	0.04	0.04	1.74	0.052
	B	2102.22	1297	0.82	0.83	0.93	0.03	0.04		
Localization	A	2034.37	1309	0.83	0.85	0.94	0.03	0.03	2.23	0.008
	B	2007.60	1297	0.83	0.85	0.94	0.03	0.03		
Ubiquity	A	2004.52	1309	0.83	0.85	0.94	0.04	0.03	2.83	0.001
	B	1970.51	1297	0.83	0.86	0.95	0.03	0.03		
Cognitive effort	A	2064.76	1309	0.82	0.86	0.94	0.04	0.03	2.08	0.015
	B	2039.85	1297	0.83	0.86	0.94	0.03	0.03		

GFI > 0.90, NFI > 0.90, CFI > 0.90, RMR < 0.08, and RMSEA < 0.06. An additional χ^2 difference test result demonstrates a significant difference between Models A and B, confirming the significant moderating effects due to personalization, localization, and cognitive efforts. Table 8 presents these hypotheses' test results, including the changes in standardized β coefficients between the low and the high groups.

Among the proposed hypotheses regarding mobile technology attributes' moderating effects, personalization (H8b), localization (H9a), and cognitive effort (H11c) were all supported. The following section discusses the implications of the confirmed moderating hypotheses as well as the insignificant moderating effect of ubiquity.

5 Discussions

5.1 Fundamental roles of m-commerce information and system quality

While both information and system quality provide value to m-commerce, existing information quality (IQ) is irrelevant to consumers' satisfaction. Alternatively, system quality (SQ) plays a more significant role than information in terms of affecting both perceived value and satisfaction with the service. Accessibility, usability, entertainment, hyperlinks, and navigation are attributes influenced by mobile technology advancement, and are critical human factors related to various limitations (i.e., the screen size, user-friendliness, or the ease and rapidity of information search and retrieval). Hence, the higher the system quality, the higher consumers' satisfaction with the service. Thus, our findings highlight SQ as the most critical component in the m-commerce environment. Our findings contrast previous findings, which state that IQ is an important contributor to satisfaction, perceived usefulness, and loyalty (Szymanski and Hise 2000; Barnes and Vidgen 2001; Zhang and Von Dran 2002; Pearson et al. 2012), in that the delivery of

Table 8 Results of hypothesized mobile technology attributes moderating effects models

Relationships within integrated model		Personalization (H8)[a]			Localization (H9)[a]			Ubiquity (H10)[b]			Cognitive effort (H11)[a]		
		Low	High		Low	High		Low	High		Low	High	
a.	IQ → SAT	−0.07	−0.03	(NS)	−0.13	0.27*	(S*)	0.02	0.13	(NH)	0.13	0.04	(NH)
b.	IQ → PV	−0.05	0.47**	(S*)	0.53**	0.10	(NS)	0.33*	−0.03	(NH)	0.18	0.45**	(NH)
c.	PV → CPREF	0.04	0.11	(NH)	0.12	−0.05	(NH)	0.20**	−0.01	(NS)	0.23**	0.01	(S*)
d.	SAT → CPREF	1.01***	0.99***	(NH)	0.87***	1.09***	(NH)	0.81***	1.29***	(NS)	0.99***	0.95***	(NS)

(S), supported; (NS), not supported; (NH), not hypothesized

* Significant at 0.10 level; ** Significant at 0.05 level; *** Significant at 0.01 level

[a] Accepted based on two-step analysis testing; [b] rejected based on two-step analysis testing

overabundant information and tailored communications are important characteristics in meeting consumers' unique needs in alignment with key website characteristics (Loiacono et al. 2002).

For practical purposes, we can prioritize the key determinants of both IQ and SQ for m-commerce based on the perceived quality levels. An order of perceived quality level for IQ is observed through relevance (REL), understandability (UND), reliability (RELB), and adequacy (ADE), while access (ACC), usability (USA), entertainment (ENT), hyperlinks (HYP), and navigation (NAV) form a sequence of perceived levels for SQ. Tables 9 and 10 note the order of perceived quality levels by consumers' classifications.

The first three orders of highly perceived IQ variables—relevance, usefulness, and understandability—did not differ among varying gender, age, and shopping frequency groups, except regarding those consumers who spent greater than an average of 200 USD. Service providers should maintain high levels of relevance, usefulness, and understandability in their provided content while continuously improving services' reliability and adequacy to improve overall IQ. Notably, consumers with high average purchase prices perceived m-commerce's reliability as the highest compared to any other consumer groups. This denotes the importance of accurate, credible information in high-transaction activities. Minor differences were also observed in the fourth and fifth perceived quality level groups, which included gender, age, and shopping frequency.

Unlike IQ, the top three highly perceived SQ variables vary among accessibility, usability, and entertainment, although both gender and shopping frequency groups display identical orders. Remarkable differences are observed when the consumers become serious in the shopping process. For example, the consumers who spend greater than 200 USD on average indicate different perception levels. M-commerce service providers should utilize this implication in improving the perception level of SQ by accommodating consumers' sincerity with their service encounters.

5.2 Moderating roles of localization, personalization, ubiquity, and cognitive effort

Regarding localized information, service providers can first utilize both the buyer's and seller's locations to facilitate efficient transactions (Garofalakis et al. 2007). While traditional e-commerce also provides benefits from location-specific information, such wired devices as conventional e-commerce media suffer from a limited ability to acquire consumers' specific geographical positions via their computers' physical IP addresses (Junglas and Watson 2003). Consumers with a high perception of localization ability, such as location-directed personalized shopping and time-specific discount offerings, indicate a higher satisfaction with m-commerce. This finding parallels not only Carlsson and Walden's (2002) assertion, in that service providers should adapt to localization, but also Mahatanankoon et al.'s (2005) suggestion that operational modes and strategies must offer consumers maximum effectiveness through value-added, location-centric, and customized mobile applications to allow m-commerce to reach its full potential.

Table 9 Perceived level of m-commerce information quality by consumer characteristics

Order	Gender		Age				Shopping frequency			Average purchase price			
	Male	Female	20 s	30 s	40 s	50 s	Weekly	Monthly	Yearly	<$50	$50–100	$100–200	$200+
1	REL	REL	REL	REL	REL	REL	REL	REL	REL	REL	REL	REL	RELB
2	USE	USE	USE	UND	USE	USE	USE	USE	USE	USE	USE	UND	REL
3	UND	UND	UND	USE	UND	UND	UND	UND	UND	UND	UND	USE	USE
4	RELB	ADE	RELB	RELB	RELB	ADE	ADE	RELB	RELB	RELB	RELB	RELB	UND
5	ADE	RELB	ADE	ADE	ADE	RELB	RELB	ADE	ADE	ADE	ADE	ADE	ADE

Table 10 Perceived level of m-commerce system quality by consumer characteristics

Order	Gender		Age				Shopping frequency			Average purchase price			
	Male	Female	20 s	30 s	40 s	50 s	Weekly	Monthly	Yearly	<$50	$50–100	$100–200	$200+
1	ACC	ACC	ACC	USA	USA	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ENT
2	USA	USA	USA	ACC	ACC	USA	USA	USA	USA	USA	USA	USA	ACC
3	ENT	ENT	ENT	ENT	NAV	ENT	ENT	ENT	ENT	ENT	ENT	ENT	NAV
4	NAV	NAV	NAV	NAV	ENT	NAV	NAV	NAV	NAV	NAV	NAV	NAV	HYP
5	HYP	HYP	HYP	HYP	HYP	HYP	HYP	HYP	HYP	HYP	HYP	HYP	USA

Second, service providers can consider personalized information to take advantage of consumers' intimate relationships with their personal mobile terminals. Service providers should simplify the user's identification by his or her technological address, further enabling a more precise determination of the consumer's position. This interaction between the consumer and the service influences perceived quality and the consumer's willingness to complete transactions (Figge 2004). Additionally, our findings indicate that such assets' appropriate utilization and leverage undoubtedly produces value-added satisfaction experiences for consumers. This supports DeLone and McLean's (2003) assertion that information quality metrics should include personalization.

Third, ubiquity plays an inconsequential role in an m-commerce context. A lack of clear visibility exists to date regarding whether ubiquity plays a supplementary or complementary role in consumers' satisfactory m-commerce experiences (Figge 2004). However, despite a conceptual understanding that ubiquity should be a significant differentiating factor between conventional e-commerce and m-commerce information systems, we found that ubiquity does not directly affect consumers' behavioral attitude or loyalty towards the service. This potentially implies that ubiquitous service should not be solely considered as an m-commerce value proposition, but also a requirement. Additionally, this result aligns with Tojib and Tsarenko's (2012) finding, in that service ubiquity does not directly affect experiential value, and perhaps only plays a supporting role in enjoyment, ease of use, and time convenience.

Finally, lower cognitive effort contributes to the perceived value of m-commerce services, which then increases the preference for mobile channels. This is consistent with Kleijnen et al.'s (2007) finding that consumers remain more attuned to overall cognitive costs compared to the benefits. Additionally, Wakefield and Whitten (2006) found that the more consumers are cognitively immersed in the use of mobile devices, the more they perceive the device's usefulness. M-commerce consumers may still expect minimal cognitive effort, and incorporate this consideration into their decisions regarding their adoption of complex technology, thus representing a principal element influencing the use of specific information systems.

5.3 Differences between m-commerce and e-commerce consumers

An initial intention of this study was to investigate the differences between m-commerce and e-commerce consumers' quality-satisfaction-behavioral intention relationships. Although we did not survey conventional e-commerce consumers for a direct comparison with m-commerce consumers, we instead performed a comparative analysis between this study's statistical results and those from previous literature. Table 11 compares the e-commerce (EC) and m-commerce (MC) loadings for each of the seven hypotheses under consideration in this study.

We demonstrate that system quality is more important than information quality for m-commerce consumers' satisfaction, compared to the e-commerce results. Similarly, the satisfaction level in an m-commerce environment greatly affects channel preferences, while perceived value has less of an effect. The actual delivery of high service satisfaction appears to be imperative, and the perceived value of

Table 11 Comparison of e-commerce and m-commerce loadings

Hypotheses	EC loadings	MC loadings
IQ → SAT	0.23[b], 0.33[a]	0.07, 0.27 (when perceived high localized IQ)
SQ → SAT	0.28[a], 0.69[c]	0.38
IQ → PV	0.28[d], 0.32[b]	0.29, 0.47 (when perceived high personalized IQ)
SQ → PV	0.30[b]	0.46
PV → SAT	0.53[f], 0.57[e]	0.46
PV → CPREF[†]	0.47[g], 0.50[f]	0.09, 0.23 (when perceived low cognitive effort)
SAT → CPREF[†]	0.39[f], 0.46[h]	0.98

[†] Behavioural intention is replaced in case of EC loadings

[a] Lin (2007), [b] Wang (2008), [c] Jing and Yoo (2013), [d] Pearson et al. (2012), [e] Patterson and Spreng (1997), [f] Kuo et al. (2009), [g] Cronin et al. (2000), [h] Udo et al. (2010)

service is no longer the main driver in an m-commerce environment. These results indicate that m-commerce consumers are seemingly sensitive to the outlook of the ordering situation (i.e., system quality and overall satisfaction), as they must make quick decisions under possible mobility. This subsequently demonstrates the necessity for continuous research efforts regarding future market orientation when dealing with an advanced mobile technology market.

6 Concluding remarks

Service providers should appropriately integrate advanced mobile technology features with respect to the newly discovered, fundamental roles of information system quality in the m-commerce context to retain and drive more consumers to m-commerce channels. First, a most compelling finding from this study was that conventional information quality does not significantly affect consumers' satisfaction lacking other specific technology attributes. Service providers can continuously improve localized and personalized content to leverage mobile technology advancement, and lead consumers to believe that service providers understand consumers' information technology norms and values. Such efforts may potentially drive consumers to be more efficient information seekers, as accentuated local-centric information is highly valuable for consumers who often engage in m-commerce in time- and location-dependent environments.

Second, service providers should acknowledge the complementary relationships between ubiquity and content delivery systems. While system quality remains a primary determinant of service success, the m-commerce channel's ubiquitous performance surprisingly has no influence on consumers' perceived quality, value, satisfaction, or channel preferences. This potentially implies that consumers who are already aware of m-commerce's advantages may have already taken this technology attribute for granted, or may consider it as a prerequisite for e-commerce service use. Tojib and Tsarenko (2012) noted that service ubiquity is a "necessary but not sufficient condition for service consumption," and that the "supporting role of

service ubiquity diminishes in the absence of motivational beliefs." Thus, we again emphasize system quality's crucial role, regardless of the obvious benefit of ubiquitous service.

Finally, consumers' perceived values did not significantly influence behavioral intentions in mobile channel preferences unless the required cognitive effort was minimized. While service providers may create a service that leverages mobile key attributes, the effort to minimize consumers' required cognitive actions is necessary to truly convince and convert conventional e-commerce consumers, and achieve m-commerce success.

Some limitations do exist in this study. First, service quality, or a quality measurement later added to DeLone and McLean's (2003) initial IS success model, was not included. This was because this study's goal was to compare two specific information system channels: conventional e-commerce channels versus m-commerce channels. However, excluding service quality satisfactorily fulfilled our survey's goal to compare two different channels, rather than one service provider versus another. Second, self-reported behavior might differ from the actual behavior. While we did not assess the actual use of m-commerce over conventional e-commerce, substantial empirical support exists regarding a causal link between intention and eventual usage behavior (Venkatesh and Davis 2000; Kim et al. 2010). Third, value propositions provided by mobile technology, such as flexibility and convenience, may differ across various wireless device-enabled services (Anckar and D'Incau 2002). Consequently, we strongly suggest that for generalizability, future studies should construct and measure various mobile value propositions and system barriers in different settings, in addition to services.

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Appendix 1: Construct measures and sources for the questionnaire

All items were measured using a 5-point Likert scale, where 1 = strongly disagree and 5 = strongly agree. General questions within each construct were not used in the Cronbach's alpha (α) computation. Inter-item correlations are reported for two-item factors. ([a]Construct dropped due to low loading on factor in confirmatory factor analysis; [b]Cronbach's alphas were computed after dropping the items with low factor loadings).

Perceived value (Adapted from Parasuraman et al. 2005) [$\alpha = 0.82^{b}$, interitem correlation = 0.70]

PV1	The overall convenience of using this m-commerce channel (MC)
PV2	The extent to which the MC gives you a feeling of being in control
PV3[a]	The prices of the products and services available at this MC (how economical MC is)
PV4[a]	The overall value you get from this MC for your money and effort

Satisfaction (Adapted from Ding et al. 2011) [$\alpha = 0.85$]

SAT1 I truly enjoyed purchasing via MC
SAT2 My choice to purchase via MC was a wise one
SAT3 I am satisfied with my purchase using MC

Channel preference (Adapted from Devaraj et al. 2002) [$\alpha = 0.87^{b}$]

CPREF1 I strongly recommend MC to others
CPREF2 For products I can buy online, I intend to completely switch over to MC (from EC)
CPREF3 I intend to increase my use of MC in the future
CPREF4[a] I plan to use MC again

Information quality (Adapted from McKinney et al. 2002) [$\alpha = 0.94$]

Based on your experience of using m-commerce, please provide your evaluation of its performance in terms of the following features. The provided m-commerce information is:

Relevance [$\alpha = 0.78$]

REL1 *Applicable* to your purchase decision
REL2 *Related* to your purchase decision
REL3 *Pertinent* to your purchase decision
REL4 In general, information is *relevant* to your purchase decision

Understandability [$\alpha = 0.82$]

UND1 Clear in meaning
UND2 Easy to comprehend
UND3 Easy to read
UND4 In general, information is *understandable* for you in making purchase decisions

Reliability [$\alpha = 0.88$]

RELB1 Trustworthy
RELB2 Accurate
RELB3 Credible
RELB4 In general, information is *reliable* for making your purchase decision

Adequacy [$\alpha = 0.84$]

ADE1 *Sufficiency* of your purchase decision
ADE2 *Completion* of your purchase decision
ADE3 Information that contains *necessary topics* for your purchase decision
ADE4 In general, is specific information *adequate* for your purchase decision

Scope[a]

SCO1 Information that covers *a wide range* (range of information)
SCO2 Information that contains *a wide variety of topics* (level of detail provided)
SCO3 In general, information covers *a broad scope* for your purchase decision

Usefulness [$\alpha = 0.87$]

USE1 *Informative* to your purchase decision
USE2 *Valuable* to your purchase decision
USE3 In general, information is *useful* in your purchase decision

System quality (Adapted from McKinney et al. 2002) [$\alpha = 0.95$]

Based on your experience of using m-commerce, please provide your evaluation of its performance in terms of the following features. The performance of the m-commerce system is:

Access [$\alpha = 0.72$]

ACC1 *Responsive* to your request
ACC2 *Quickly loads* all the text and graphics
ACC3 In general, MC system provides *good access*

Usability [$\alpha = 0.88$]

USA1 *A simple layout* for its contents
USA2 Easy to use
USA3 Well organized
USA4 A clear design
USA5 In general, MC system is *user-friendly*

Entertainment [$\alpha = 0.90$]

ENT1 Visually attractive
ENT2 *Fun* to navigate
ENT3 *Interesting* to navigate
ENT4 In general, MC system is *entertaining*

Hyperlinks [$\alpha = 0.89$]

HYP1 An adequate number of links
HYP2 Clear descriptions for each link
HYP3 In general, MC system has appropriate hyperlinks

Navigation [$\alpha = 0.84$]

NAV1 It is *easy to go back and forth* between pages
NAV2 Provides *a few clicks* to locate information
NAV3 In general, MC system is *easy to navigate*

Interactivity[a]

INT1 Provides *the capability to create a list of selected items* (such as a shopping cart)
INT2 Provides *the capability to change items from a created list* (such as changing the contents of a shopping cart)

INT3 Provides *the capability to create a customized product* (such as computer configuration or creating clothes appropriate to your taste and measurements)
INT4 In general, MC system can *actively participate in creating your desired product*

Mobile technology attributes and system barrier

Personalization (Adapted from Wang and Li 2012) [$\alpha = 0.84$]

PERS1 I feel that my personal needs have (relatively) been met when using MC
PERS2 I feel that my MC Service provider has the (relatively) same norms and values that I have
PERS3 My MC Service provider (relatively better) provides me with information regarding its services, according to my preferences
PERS4 There are numerous ways to submit inquiries to my MC service provider

Localization (Adapted from Wang and Li 2012) [$\alpha = 0.83$[b], interitem correlation = 0.71]

LOC1[a] My MC Service provider is capable of identifying my location and providing me with the on-the-spot information I need
LOC2[a] My MC Service provider can accurately locate me using GPS or information stored on my mobile device
LOC3 I can receive personalized marketing information (e.g., shopping offers, advertisements, coupons, etc.) from my MC Service provider
LOC4 My MC Service provider can offer me timely and location-specific packets of information

Ubiquity (Adapted from Tojib and Tsarenko 2012 and Choi et al. 2008) [$\alpha = 0.92$]

UBI1 I can use MC anytime
UBI2 I can use MC anywhere
UBI3 I can use MC when needed
UBI4 I can access MC while traveling

Cognitive effort (Adapted from Kleijnen et al. 2007) [$\alpha = 0.77$[b], interitem correlation = 0.63]

COG1[a] MC will likely be uncomplicated to use (reverse-scored)
COG2 MC will likely require much effort to understand its use
COG3 I believe it will be difficult to learn how MC works

Appendix 2: Results of full moderating effects model

Relationships within integrated model	Personalization (H8)[a]			Localization (H9)[a]			Ubiquity (H10)[b]			Cognitive effort (H11)[a]		
	Low	High		Low	High		Low	High		Low	High	
IQ → SAT	−0.07	−0.03	(NS)	−0.13	0.27*	(S*)	0.02	0.13	(NS)	0.13	0.04	(NS)
IQ → PV	−0.05	0.47**	(S*)	0.53**	0.10	(NS)	0.33*	−0.03	(NS)	0.18	0.45**	(NS)
PV → CPREF	0.04	0.11	(NS)	0.12	−0.05	(NS)	0.20**	−0.01	(NS)	0.23**	0.01	(S*)
SAT → CPREF	1.01***	0.99***	(NS)	0.87***	1.09***	(NS)	0.81***	1.29***	(NS)	0.99***	0.95***	(NS)
SQ → SAT	0.31**	0.36**	(NS)	0.41***	0.23*	(NS)	0.56***	0.15	(S**)	0.22*	0.47***	(NS)
SQ → PV	0.48***	0.30**	(NS)	0.30**	0.50**	(NS)	0.39***	0.52***	(NS)	0.57***	0.32**	(NS)
PV → SAT	0.34***	0.47***	(NS)	0.40***	0.50***	(NS)	0.38***	0.47***	(NS)	0.55***	0.38***	(NS)

(S), supported; (NS), not supported

* Significant at 0.10 level; ** Significant at 0.05 level; *** Significant at 0.01 level

[a] Accepted based on two-step analysis testing; [b] rejected based on two-step analysis testing

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