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Understanding the emergence of wearable devices as next-generation tools for health communication

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1. INTRODUCTION

The rapid advancement of information and communication technology (ICT) in recent years has enabled the design and production of compact mobile devices with robust computing power and battery life. Consequently, the physical sizes of these devices are significantly reduced so that they can now be worn by users in the form of a watch, glasses, or clothing instead of being carried, thereby literally allowing wearable computing. More importantly, the introduction and development of wearable devices have granted the anywhere-anytime access to information (Kim & Shin, 2015), and thus they are emerging as the next-generation tools for ubiquitous communication. For the healthcare industry, this boundless accessibility is especially important because patients' health conditions, including heart rate, calorie burn, sleep quality, and intensity of physical activities (Blakeway, 2014), can be remotely and constantly monitored, stored, and analyzed without boundaries via wearable devices equipped with health-related functions.

Despite the important role of wearable devices in healthcare, limited research has investigated users' motivational factors for using wearable healthcare devices and how the industry can promote the adoption of wearable devices in the healthcare sector. This is perhaps because wearable devices are still relatively new products that have not yet reached the mass market. Therefore, this study intends to explore key psychological factors that motivate users to utilize wearable devices for their health, and examine how these factors contribute to predicting the overall adoption of wearable healthcare devices by integrating them with the technology acceptance model (TAM). The validity of the integration and its predictability is tested via structural equation modeling (SEM).

2. Literature Review

2.1. Wearable Devices and Wireless Healthcare

Wearable devices are defined as "electronic devices that provide the functions of a computer or system, and are able to be attached to or worn on the body" (Buenaflor & Kim, 2012), and are typically classified into four categories (see Table 1): Accessory, clothing, body-mounted, and bio-implant. Kim and Shin (2015) noted that wearable devices are increasingly becoming ubiquitous tools for communication and the meaning of mobility consequently evolved from "merely carriable" to "seamlessly wearable" technology. They also identified mobility (i.e., anywhere-ness) and availability (i.e., anytime-ness) as the key strengths of wearable devices. This anywhere-anytime accessibility of wearable devices is what makes them next-generation tools for health communication, providing boundless and real-time information while being attached to users' bodies and continuously monitoring and tracking users' health conditions such as heart rate, body temperature, calories burned, sleep patterns, and perspiration.

[Insert Table 1 about here]

In response to the increasing popularity of wearable devices, several studies have been conducted to explore motivational factors for using the devices. For example, Ko, Sung, and Yun (2009) employed the information diffusion theory introduced by Rogers (1983), and showed that users' perceived compatibility, relative advantage, and complexity are significantly associated with users' intention to purchase smart clothing. Similarly, Che (2009) developed an integrated acceptance model based on TAM (Davis, 1989), and showed that perceived usefulness plays a critical role in shaping users' attitudes toward smart clothing. More recently, Kim and Shin

(2015) examined the user acceptance pattern of smartwatches and identified affective quality, relative advantage, mobility, availability, subcultural appeal, and cost as key psychological determinants of the adoption of wearable devices.

In mobile healthcare, the integration of wireless technology is critical to the success of wearable healthcare devices. Therefore, various network technologies have been applied to mobile healthcare devices. For example, Jovanov et al. (2002) developed a wireless intelligent sensor for monitoring users' stress levels, which can be applied to mobile health monitoring applications. Korhonen, Parkka, and Gils (2003) proposed a wrist-worn sensor that monitors users' physical activity and sends the data to a home network via unidirectional radio frequency transmission. Khoor, Nieberl, Fugedi, and Kail (2002) introduced a wireless communication protocol using the Bluetooth connection for collecting electrocardiogram data in remote locations.

The adoption of both wireless and wearable technologies is not only effective in reducing medical costs, but also allows healthcare service providers to increase their productivity. Therefore, the integration of wireless and wearable technologies in the healthcare industry is considered a promising solution to delivering affordable services that meet patients' needs (Darwish & Hassanien, 2011; Kim et al., 2014; Lopez, Shuzo, & Yamada, 2011; Sagahyroon et al., 2009).

3. Research Hypotheses

3.1. Technology Acceptance Model

Examining the user acceptance pattern of new technological products or services is an effective method for predicting their market success (Gagnon, 2003). Among various theoretical models that have been developed for explicating such a pattern, TAM (Davis, 1989; Davis et al., 1989) is perhaps the most extensively utilized and replicated research framework in decades. The original TAM consists of four factors, including perceived ease of use, usefulness, attitude, and intention to use, and suggests that a technology perceived as easy to use is also perceived to be useful for completing user tasks, together inducing positive attitudes toward the technology. Positively enhanced usefulness and attitude then lead to greater usage intention of the novel technology.

TAM has been constantly validated as a useful theoretical framework for examining usage intention of various devices, especially in healthcare and mobile contexts. For example, Pai and Huang (2011) integrated the factors of information, service, and system qualities with the original TAM and explored how they contribute to the usage intention of healthcare planning and hospital information systems. In addition, Wu, Wang, and Lin (2007) proposed a revised TAM for explaining users' intentions to use mobile healthcare systems and showed that compatibility, self-efficacy, and technical support are key determinants of the system adoption.

In the mobile context, Kim and his colleagues adopted TAM as a basic framework for investigating the adoption patterns of mobile devices, including smartphones and smartwatches, and demonstrated how the correlational relationships in TAM help understand user acceptance of mobile technology (Kim & Shin, 2015; Kim & Sundar, 2014). In addition, Liang, Xue, and Byrd (2003) investigated the adoption of personal digital assistants (PDAs) in healthcare practices by validating an extended TAM, and suggested that compatibility and job relevance of PDAs as well as users' innovative tendencies play influential roles in promoting the actual PDA usage. Similarly, Han et al. (2005) investigated user acceptance of a mobile medical information system by employing TAM and identified perceived usefulness as a key factor of the system usage. In accordance with the literature reviewed thus far, this study proposes the following hypotheses pertaining to the role of the TAM factors in predicting the adoption of wearable healthcare devices:

H1. Positive attitude toward wearable healthcare devices will lead to stronger intention to use the devices.

H2. Perceived usefulness of wearable healthcare devices will lead to stronger intention to use the devices.

H3. Perceived usefulness of wearable healthcare devices will lead to a more positive attitude toward the devices.

H4. Perceived ease of use of wearable healthcare devices will lead to a more positive attitude toward the devices.

H5. Perceived ease of use of wearable healthcare devices will lead to greater usefulness of the devices.

3.2. Interactivity

Interactivity refers to the capacity of two or more units or users to communicate with or respond to each other in a way that results in one being influenced by the other (Laurel, 1993). Interactivity allows users to comprehend and adapt to their environment while increasing their abilities (Barnett, 1999). Cyr, Head, and Ivanov (2009) argued that the sense of control, connectedness, and responsiveness are critical components of interactivity, and found that websites with greater interactivity are perceived to be more efficient, effective, enjoyable, and trustworthy, which then lead to stronger loyalty to the websites. Similarly, studies have consistently found that interactivity enhances efficiency and usefulness of various information communication technologies (Cross & Smith, 1996; Hong, Thong, Wong, & Tam, 2002; Huang, 2005; Koufaris, 2002). In accordance with these findings, we predict that the interactivity of wearable healthcare devices will have similar positive effects, and thus propose the following hypotheses:

H6. Wearable healthcare devices with greater interactivity will be perceived to be easier to use.

H7. Wearable healthcare devices with greater interactivity will be perceived to be more useful.

3.3. Perceived Control

Perceived control is defined as the degree to which users believe that they have control over a device or service, and is positively associated with a sense of readiness, efficiency, and accessibility that increases users' confidence in completing their tasks while reducing time and mental effort (Craik, 1943; Kim & Sundar, 2014). ICT that provides users with a greater sense of control is perceived to be easy to use and useful for completing users' tasks. For example, Kim and Sundar (2014) showed that a large screen size as compared to a small screen size of smartphones induces greater perceived control, which then positively affects the utilitarian qualities of the technology, such as perceived ease of use and usefulness. Similarly, studies have found that the enhanced sense of perceived control leads to greater usage intention of mobile banking (Luarn & Lin, 2005) and mobile social network games (Park et al., 2014). Therefore, this study hypothesizes the following:

H8. Wearable healthcare devices with greater control will be perceived to be easier to use.

H9. Wearable healthcare devices with greater control will be perceived to be more useful.

3.4. Personal Innovativeness

Innovativeness refers to the individual tendency of adopting new products or services comparatively earlier than others (Lassar, Manolis, & Lassar, 2005; Zhang, Li, & Sun, 2014), which has been consistently studied as a key determinant of consumer behavior and acceptance of novel technology (Agarwal & Prasad, 1998; Agarwal et al., 1998; Rogers, 1983). Innovativeness is an individual tendency or characteristic such that those who possess a high innovativeness are more likely to experiment with and adopt a new technology. For example, Lassar, Manolis, and Lassar (2005) found that the adoption of online banking services is positively influenced by users' personal innovativeness, and Lu (2014) demonstrated that users' personal innovativeness leads to greater usage intention of mobile commerce. Therefore, this study hypothesizes that users' innovative tendencies will play a critical role in the adoption of wearable healthcare devices.

H10. Users with a greater tendency for innovativeness will have stronger intention to use wearable healthcare devices.

3.5. Perceived Cost

Although the concept of cost has typically focused on the absolute monetary value of a product (Tornatzky & Klein, 1982), this concept has now extended to include psychological and intangible values, economic feasibility, and mental efforts associated with purchase and maintenance of the product (Moore & Benbasat, 1991). Moore and Benbasat (1991) indicated that the concept of cost consisted of two layers: actual price as a primary attribute and individual perception of cost as a secondary attribute, both of which significantly affect the innovation adoption. Moreover, Huijts, Molin, and Steg (2012) found that the adoption of a particular technology is largely influenced not only by the actual cost, but also by the perceptual benefit and mental efforts associated with purchasing or using the technology.

Accordingly, this study defines cost as the economic and psychological efforts required for using wearable healthcare devices. Studies have shown that an increase in perceived cost restricts the adoption of new information and communication technology. For example, Kim and Shin (2015) found that the perceived cost of smartwatches has negative effects on user intention to use wearable devices. Similarly, perceived cost is found to be negatively associated with the adoption of the Radio Frequency Identification (RFID) system used in the healthcare industry (Chong & Chan, 2012). Based on these findings, this study predicts that the perceived cost of wearable healthcare devices will have similar negative effects on usage intention.

H11. Perceived cost of wearable healthcare devices will have a negative effect on intention to use the devices.

3.6. Research Model

Figure 1 depicts a research model based on the proposed hypotheses.

[Figure 1. Proposed research model.]

4. METHOD

Thirty mobile healthcare device users (with over six months of usage experience) participated in in-depth interviews that were designed to identify factors relevant to wearable healthcare devices. Ten factors were identified, and among them, interactivity, control, innovativeness, and cost were selected as the final factors by query analyses (Table 2). The researchers conducted literature reviews on these four factors and acquired a total of 35 questionnaire items from prior studies that assessed them. Items for interactivity were adopted from Cheng (2013) and Paechter, Maier, and Macher (2010), while items for perceived control were adopted from Koufaris (2002) and Park, Baek, Ohm, and Chang (2014). In addition, items for personal innovativeness were adopted from Lee, Park, Chung, and Blakeney (2012), Morosan (2012), and Zhang, Li, and Sun (2014). Lastly, items for perceived cost were adopted from Kim et al. (2014) and Park and Ohm (2014). The selected items were revised and finessed by five university professors in the fields of health communication, psychology, and business.

[Insert Table 2 about here]

After the revision, three rounds of a pilot pen-pencil survey were conducted with 30 students who had more than one year of experience with mobile healthcare devices. They were also asked to comment as to whether any of the questionnaire items were misleading or unclear. Next, Cronbach's alpha values were obtained in order to examine the internal consistency among the items. After this procedure, nine items were removed, and a total of 26 questionnaire items remained as the final items for the main survey.

The four constructs from the original TAM (i.e., perceived ease of use, perceived usefulness, attitude, and intention to use) were measured by items adopted from Davis (1989) and Kim and Sundar (2014). All variables were measured on 7-point Likert scales with anchors of 1 = strongly disagree and 7 = strongly agree. The final questionnaire items used in this study are reported in Table 3.

[Insert Table 3 about here]

A professional consulting agency administered the survey online for three months in South Korea. Utilizing their existing data pool, the agency sent out 5,000 emails to smartphone users and collected a total of 927 responses from users who purchased their wearable devices (e.g., smartwatches, smartbands) specifically for health-related purposes. After data filtering, 877 valid responses remained. The demographic information of the respondents is reported in Table 4.

[Insert Table 4 about here]

5. Results

5.1. *Descriptive Analysis*

Descriptive statistics of the collected data are reported in Table 5.

[Insert Table 5 about here]

5.2. *Validity Tests*

A confirmatory factor analysis (CFA) and structural equation modeling (SEM) were conducted with the AMOS 18 statistical software in order to validate the proposed hypotheses and test the overall explanatory strength of the research model. As recommended in prior research (Anderson & Gerbing, 1988), this study obtained a sample size larger than 200 for greater validity. All values of Cronbach's alpha, composite reliability, and factor loadings were above 0.7. In addition, the values of average variance extracted (AVE) were above 0.5, and the degrees of correlation between two particular constructs were lower than the square root values of the AVE. All these findings demonstrate that this study successfully met the recommended criteria for strong validity (see Table 6 and 7).

[Insert Table 6 about here]

[Insert Table 7 about here]

5.3. *The Measurement and Structural Models*

As reported in Table 8, both measurement and structural models had strong fit indices, confirming the validity of the adopted measures and hypothesized relationships.

[Insert Table 8 about here]

5.4. Hypothesis Testing

As summarized in Table 9 and Figure 2, all hypotheses were supported except H11. Attitude (H1, $\beta = 0.349$, $CR = 10.629$, $p < 0.001$), perceived usefulness (H2, $\beta = 0.430$, $CR = 11.846$, $p < 0.001$), and personal innovativeness (H10, $\beta = 0.197$, $CR = 7.605$, $p < 0.001$) had positive effects on intention to use wearable healthcare devices. However, perceived cost had no significant effects on intention (H11, $p > 0.05$).

Perceived usefulness (H3, $\beta = 0.717$, $CR = 21.281$, $p < 0.001$) and perceived ease of use (H4, $\beta = 0.165$, $CR = 5.509$, p < 0.001) were positively associated with attitude. In addition, interactivity (H7, $\beta = 0.389$, $CR = 10.582$, $p < 0.001$), perceived control (H9, $\beta = 0.492$, $CR = 12.984$, p < 0.001), and perceived ease of use (H5, $\beta = 0.157$, $CR = 6.414$, $p < 0.001$) led to greater perceived usefulness. Moreover, interactivity (H6, $\beta = 0.139$, CR = 2.355, p < 0.05) and perceived control (H8, $\beta = 0.195$, CR = 3.340, $p < 0.001$) were found to have positive effects on perceived ease of use.

With regard to the variance in intention, 66.9% was contributed by personal innovativeness, perceived usefulness, and attitude, and 49.3% of the variance in attitude toward the devices was accounted by perceived usefulness and ease of use. Finally, the standardized total effects revealed that perceived usefulness had the greatest effect on both intention and attitude (see Figure 3 and 4).

[Insert Table 8 about here]

[Figure 2. Proposed research model with significant standardized path coefficients. *$p < 0.05$, **$p < 0.001$]

[Figure 3. Standardized total effects on intention to use.]

[Figure 4. Standardized total effects on attitude.]

5.5. Supplemental Analyses

This study conducted additional structural analyses in order to examine whether the adoption of wearable health devices differs among groups of users with different gender, age, previous experience, and education level. Results indicated that the acceptance pattern revealed in our research model (Figure 2) was consistently found in all groups, regardless of the individual differences.

6. DISCUSSION

This study identifies interactivity, control, innovativeness, and cost as key motivational factors for using wearable healthcare devices, and explicates the process by which these four factors are integrated with the TAM constructs and contribute to the adoption of the devices. The results from the SEM analysis show that the factors are indeed significant predictors of the adoption, with perceived usefulness emerging as the most influential determinant of both attitude and intention. In addition, the effects of perceived control and interactivity are found to be higher than that of personal innovativeness and perceived cost, suggesting the importance of designing a highly interactive and easily controllable user interface for wearable healthcare devices.

As revealed in the results, perceived usefulness played a primary role in determining both user attitude and intention, while the two external factors (i.e., control and interactivity) significantly enhanced the usefulness and ease of use of wearable healthcare devices. More specifically, the magnitude of the effect of interactivity on usage intention was higher than that of perceived control, and the effect of perceived control on user attitude was greater than the effect of interactivity (see Figure 3 and 4). These findings suggest that a well-designed user interface or structural feature that offers greater interactivity and control is essential to the utilitarian efficiency of wearable healthcare devices.

Another intriguing finding is the confirmation of personal innovativeness as a significant predictor of usage intention. This suggests that the adoption of a new technology is affected not only by the psychological qualities of the technology, but also by users' individual differences or characteristics such as innovative tendency. On the contrary, the perceived cost of wearable healthcare devices showed no significant effects on usage intention, although we expected negative effects of cost. This is perhaps because our data was collected from survey respondents who were motivated to purchase their wearable devices specifically for better health, and thus they might have been willing to dedicate their financial, mental, and physical efforts to maintain and improve their health conditions. In addition, the majority of respondents were over 30 years of age with college or graduate degrees living in metropolitan areas, implying that they were likely to be both socially and financially capable of purchasing their devices regardless of cost.

Our findings provide both theoretical and practical implications for researchers and designers. From a theoretical perspective, this study extends the validity of TAM by integrating the two main external factors (i.e., interactivity and control) with the original TAM framework, demonstrating the theoretical ability of TAM for predicting ICT adoption. More specifically, this study provides a greater understanding of the structural relationship among usability (i.e., interactivity and control), efficiency (i.e., usefulness and ease of use), and individual user characteristics (i.e., innovativeness), with implications for other service domains that may benefit from using the wearable platform. In addition, extended TAM models that integrate both hedonic and utilitarian aspects of technology are believed to be more effective in predicting the adoption of convergent media than the traditional TAM alone. Therefore, the identification of interactivity (i.e., hedonic) and control (i.e., utilitarian) as equally important predictors of the adoption implies the explanatory power of our proposed model.

A practical value of this study lies in that the proposed model offers insights into the adoption pattern of the increasingly popular ICT device in the healthcare market. In addition, device manufacturers and the healthcare industry can draw design and engineering ideas from our research model. Developers should attempt to create highly interactive and easily controllable interfaces for wearable healthcare devices that maximize the efficiency and usability of the devices by employing the user-oriented, rather than technology-driven, approaches in the development process. Moreover, such interfaces should also be designed in a way that they can further stimulate users' innovative tendency to experiment with new technological products.

Several issues should be taken into consideration in future research. First, this study does not investigate factors that are directly related to technical components of wearable devices that may have notable effects on user experience. Given that variations in the weight and raw material of the devices as well as display screen size are likely to affect user satisfaction and the ways in which devices are utilized, incorporating one of these technical features in future research will aid in providing valuable design and engineering guidelines. In particular, functional and structural features that can attract elderly users should be more emphasized.

Second, the findings of this study may not be generalizable to explicate the acceptance of wearable devices in contexts other than in healthcare. Wearable healthcare device users are likely to be more self-motivated and conscious about their health and thus have a concrete goal for purchasing the devices. Similarly, the survey respondents of this study are likely to be early adopters and power users given that they have actually purchased wearable devices even at the current introductory stage of the technology. Therefore, the acceptance pattern discovered in this study may not be applicable to wearable device usage in hedonic, entertaining purposes and to non-power users. By addressing these limitations, future studies will be able to extend our findings and propose a more generalizable and both technically and psychologically comprehensive model.

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Table 1. Types of wearable devices.

Type	Description	Example
Accessory	Watch, glasses, or necklace types	Smartwatch, smartglasses
Clothing	Mounted onto clothing	Smartwear, clothing-assembled computer, sensors mounted in textile goods
Body-mounted	Attached to user's body	Skin-patch formed sensor or devices
Bio-implant	Implanted in user's body	Implantable sensors or devices

Table 2. Results of the query analyses showing the factors relevant to wearable healthcare devices.

	Factor	Query ($N = 137$)
1	Interactivity	39
2	Personal innovativeness	32
3	Cost	20
4	Control	19
5	Enjoyment	10
6	Mobility	5
7	Others	12

Table 3. The questionnaire items used in the main survey.

Construct		Item
Interactivity	IN1	Wearable healthcare devices respond quickly to my request.
	IN2	I can acquire valuable and relevant information when using wearable healthcare devices.
	IN3	I can customize wearable healthcare devices.
	IN4	Wearable healthcare devices respond appropriately to my request.
Perceived control	CON1	Using wearable healthcare devices doesn't make me feel disturbed.
	CON2	I can fully control wearable healthcare devices when I use them.
	CON3	Overall, I can control wearable healthcare devices well.
Personal innovativeness	PI1	If I heard about a new technological product, I would look for ways to gain experience with it.
	PI2	Among my friends, I am usually the first one to attempt to use a new technological product.
	PI3	I like to experiment with a new technological product.
	PI4	In general, I am not hesitant to try out a new technological product.
Perceived cost	PC1	I think the purchasing cost of wearable healthcare devices is expensive.
	PC2	It takes a huge amount of mental/physical effort and cost to use wearable healthcare devices.
	PC3	I think the maintenance cost of using wearable healthcare devices is expensive.
Perceived ease of use	PEOU1	Using wearable healthcare devices does not require a lot of mental effort.
	PEOU2	I find wearable healthcare devices easy to use.
	PEOU3	I find it easy to access and use wearable healthcare devices when and where I want.
Perceived usefulness	PU1	I think wearable healthcare devices are useful.
	PU2	It would be comfortable for me to use wearable healthcare devices.
	PU3	Wearable healthcare devices are a beneficial tool in my life.
	PU4	Using wearable healthcare devices improves my job performance and effectiveness.
Attitude	ATT1	Using wearable healthcare devices is generally good.
	ATT2	Using wearable healthcare devices is generally a wise idea.
	ATT3	I strongly support the use of wearable healthcare devices.
	ATT4	I have positive feelings toward wearable healthcare devices in general.
Intention to use	IU1	I am likely to use wearable healthcare devices in the near future.
	IU2	I predict that wearable healthcare devices will be more widely adopted by our society in the near future.
	IU3	If I could, I would like to use wearable healthcare devices.
	IU4	I would rather use wearable healthcare devices than other healthcare devices.

Table 4. Demographic information of survey respondents ($N = 877$).

Age	***N*** (%)	Usage period	***N*** (%)
20-29	271 (30.9%)	3-6 months	191 (21.8%)
30-39	351 (40.0%)	6-12 months	407 (46.4%)
40-49	171 (19.5%)	1-2 years	216 (24.6%)
50-59	51 (5.8%)	Over 2 years	63 (7.2%)
Above 59	33 (3.8%)		
Education	***N*** (%)	Gender	***N*** (%)
High school or below	204 (23.3%)	Male	498 (56.8%)
College	491 (56.0%)	Female	379 (43.2%)
Graduate or above	182 (20.8%)		
Living area	***N*** (%)		
Metropolis	522 (59.5%)		
Small and medium-sized cities	291 (33.2%)		
Rural area	64 (7.3%)		

Table 5. Mean and standard deviations of the constructs.

Constructs	Mean	Standard deviation
Interactivity	4.04	1.05
Perceived control	4.22	0.95
Personal innovativeness	4.19	0.96
Perceived cost	3.54	0.99
Perceived ease of use	4.07	1.10
Perceived usefulness	4.31	0.81
Attitude	4.26	1.07
Intention to use	4.10	0.94

Table 6. Convergent and internal validity.

Construct	Item	Internal validity			Convergent reliability	
		Cronbach's alpha	Item-total correlation	Factor loadings	Composite reliability	Average variance extracted
Interactivity	IN1	0.913	0.872	0.841	0.918	0.737
	IN2		0.880	0.812		
	IN3		0.905	0.901		
	IN4		0.906	0.877		
Perceived control	CON1	0.949	0.953	0.791	0.878	0.707
	CON2		0.958	0.904		
	CON3		0.947	0.824		
Personal innovativeness	PI1	0.927	0.878	0.922	0.908	0.711
	PI2		0.917	0.786		
	PI3		0.913	0.841		
	PI4		0.913	0.819		
Perceived cost	PC1	0.862	0.877	0.906	0.865	0.682
	PC2		0.944	0.816		
	PC3		0.833	0.748		
Perceived ease of use	PEOU1	0.884	0.862	0.795	0.885	0.720
	PEOU2		0.917	0.851		
	PEOU3		0.923	0.896		
Perceived usefulness	PU1	0.930	0.897	0.859	0.924	0.754
	PU2		0.906	0.891		
	PU3		0.927	0.894		
	PU4		0.906	0.827		
Attitude	ATT1	0.892	0.843	0.719	0.904	0.704
	ATT2		0.905	0.794		
	ATT3		0.899	0.905		
	ATT4		0.837	0.921		
Intention to use	IU1	0.922	0.890	0.829	0.919	0.740
	IU2		0.883	0.881		
	IU3		0.909	0.913		
	IU4		0.920	0.815		

Table 7. Discriminant validity.

Construct	1	2	3	4	5	6	7	8
1. IN	0.858							
2. CON	0.420	0.841						
3. PI	0.419	0.297	0.843					
4. PC	-0.327	-0.649	-0.629	0.826				
5. PEOU	0.011	0.042	0.033	-0.059	0.849			
6. PU	0.398	0.160	0.137	-0.116	0.012	0.868		
7. ATT	0.464	0.179	0.286	-0.170	0.158	0.352	0.839	
8. IU	0.474	0.144	0.493	-0.165	0.023	0.244	0.227	0.860

Note: Diagonal positions show the square root degrees of average variance extracted.

Table 8. Fit indices of the measurement and research models.

Fit index	The measurement model	The research model	Recommended value	Source
χ^2/d.f.	4.023	4.117	< 3.000	Anderson & Gerbing (1988), Bentler & Bonnet (1980), Browne & Cudeck (1993), Fornell & Larcker (1981), Hair et al. (2006), Hoe (2008), Joreskog & Sorbom (1996)
AGFI	0.917	0.902	> 0.900	
NFI	0.914	0.907	> 0.900	
IFI	0.907	0.905	> 0.900	
CFI	0.907	0.912	> 0.900	
GFI	0.927	0.922	> 0.900	
SRMR	0.071	0.079	< 0.080	
RMSEA	0.064	0.069	< 0.080	

Note: AGFI = Adjusted goodness-of-fit index; NFI = normed fit index; IFI = incremental fit index; CFI = comparative fit index; GFI = goodness-of-fit index; SRMR = standardized root mean square residual; RMSEA = root mean square error of approximation

Table 9. Results of the hypothesis test.

Hypothesis	Standardized coefficient	SE	CR	Supported
H1. ATT → IU	0.349**	0.037	10.629	Yes
H2. PU → IU	0.430**	0.045	11.846	Yes
H3. PU → ATT	0.717**	0.037	21.281	Yes
H4. PEOU → ATT	0.165**	0.035	5.509	Yes
H5. PEOU → PU	0.157**	0.026	6.414	Yes
H6. IN → PEOU	0.139*	0.055	2.355	Yes
H7. IN → PU	0.389**	0.037	10.582	Yes
H8. CON → PEOU	0.195**	0.053	3.340	Yes
H9. CON → PU	0.492**	0.036	12.983	Yes
H10. PI → IU	0.197**	0.029	7.605	Yes
H11. PC → IU	-0.018	0.027	-0.853	No

*$p < 0.05$, **$p < 0.001$