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An acceptance model for smart watches: Implications for the adoption of future wearable technology

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Abstract

Purpose – The purpose of this paper is to identify the key psychological determinants of smart watch adoption (i.e. affective quality (AQ), relative advantage (RA), mobility (MB), availability (AV), subcultural appeal) and develops an extended technology acceptance model (TAM) that integrates the findings into the original TAM constructs.

Design/methodology/approach – An online survey assessed the proposed psychological determinants of smart watch adoption. Confirmatory factor analysis (CFA) and structural equation modeling (SEM) were conducted on collected data ($n = 363$) using the AMOS 22 statistical software. The reliability and validity of the measurement assessing the proposed factor structure were examined via CFA, while the strength and direction of the hypothesized causal paths among the constructs were analyzed via SEM.

Findings – The AQ and RA of smart watches were found to be associated with perceived usefulness, while the sense of MB and AV induced by smart watches led to a greater perceived ease of the technology's use. The results also indicated that the devices' subcultural appeal and cost were notable antecedents of user attitude (AT) and intention to use, respectively.

Originality/value – Though smart watches are becoming increasingly popular, empirical studies on user perceptions of and ATs toward – them remain preliminary. This paper is one of the first scholarly attempts at a systematic prediction of smart watch usage, with implications for the adoption of future wearable technology.

Keywords Integrated acceptance model, Smart watch, Wearable technology

Paper type Research paper

1. Introduction

While the recent technological advancements in and the worldwide popularity of mobile devices such as smartphones and tablet computers have granted anytime-anywhere accessibility to information, the meaning of "mobility" is evolving from merely carriable to seamlessly wearable technology, advancing the ubiquity of personal communication to the next level. In particular, smart watches (e.g. Samsung Galaxy Gear, Pebble E-Paper Watch) have been highly hyped in the information and communications technology (ICT) industry for a multi-functionality that appeals to a broad range of user interests, including not only fitness, health-monitoring, and location tracking but also extended communication and "smart" features (McIntyre, 2014). Recent polls on smart watch adoption forecast that the market will continue to grow at an exponential rate: 15 million units are expected to be sold globally in 2014, 91.6 million by 2018, and 373 million by 2020 (Danova, 2013; NextMarket Insights, 2013).

Despite smart watches' high ratings on the "hype-o-meter," empirical investigations on how user perceptions of and attitudes (ATs) toward the technology are shaped have

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not been sufficiently conducted, and relevant studies are still preliminary. Therefore, this study examines a number of the key psychological factors (i.e. affective quality (AQ), relative advantage (RA), mobility (MB), availability (AV), subcultural appeal, cost) closely associated with wearable technology and explicates how these factors contribute to determining user acceptance of smart watches by integrating them with the technology acceptance model (TAM). This study thereby intends to develop a research model enabling a systematic prediction of smart watch usage, with implications for the adoption of future wearable technology.

2. Theoretical background

2.1 Smart watches

Although digital wristwatches originally appeared with the 1972 debut of the Hamilton Pulsar P1, the first smart watch capable of doing more than indicating the date and time arrived in 1982 with Seiko's Pulsar NL C01, which incorporated user-programmable memory (Charlton, 2013). Seiko continued to develop smart watch technology throughout the early 1980s, with their Data 2000 and RC-1,000 series offering an external keyboard for data entry and data transfer from computers via cable (Marshall, 2013). As technological development, miniaturization, and the mass production of cheaper and faster electronic parts become possible, digital watches started to evolve into the modern smart watch by incorporating an increasing number of smart features with high-computing power. IBM teamed up with Citizen to develop a watch that ran Linux and introduced a prototype smart watch in 2000, the WatchPad, with a 32-bit ARM processor, 16 megabytes of memory, fingerprint scanner, speaker, and microphone (Charlton, 2013). In 2003, Microsoft introduced wireless connectivity for smart watches with its SPOT watch by utilizing FM radio broadcast signals to deliver information to the device.

Although Microsoft understood that wireless was the future of smart watches, the technology that shaped the current smart watch trend was not FM but Bluetooth (Marshall, 2013). The relentless development of smartphones and related ICT technologies has created a unique digital environment in which consumers use both smartphones and smart watches simultaneously. Smart watches are not expected to replace smartphones but to serve mostly as satellite devices for amassing useful data from a paired smartphone via wireless Bluetooth connection and providing more convenient, faster, and substitutable access to information, especially as its information processing is less demanding and using a smartphone is sometimes impractical. This characteristic of smart watches distinguishes them from other mobile devices, making them technologically and psychologically unique communication tools that merit further investigation.

2.2 TAM

As new technologies are constantly being developed and commercialized in the current era of the increasingly digital world, various theoretical models have been proposed to explicate the technology adoption process. In particular, TAM is one of the most extensively utilized theoretical models for studying the end-user acceptance of ICT. The original TAM posits that perceived ease of use (PEOU) and perceived usefulness (PU) are the key psychological determinants of user AT, and intention to use (IU) (Davis, 1989, 1993). When a particular technology or service is perceived to be easy to operate, users tend to believe that the technology is useful and form favorable ATs toward it. Enhanced PU and AT then positively influence user intention to adopt and use the technology.

The explanatory power and parsimony of the TAM framework have been consistently validated by numerous studies on the user acceptance of various mobile-based technologies and services, including smartphones (Joo and Sang, 2013; Kim and Sundar, 2014), tablet computers (Park and del Pobil, 2013), e-book readers (Jung *et al.*, 2011), mobile cloud computing (Park and Kim, 2014), and long-term evolution (LTE) services (Park and Kim, 2013). Therefore, this study adopts TAM as the basic theoretical framework for investigating the user acceptance of wearable technology and predicts that the documented strong correlations among PEOU, PU, AT, and IU will be observed in smart watch adoption. The following hypotheses concerning TAM will be confirmed if smart watch adoption can indeed be explicated through the TAM framework:

H1. AT will have positive effects on intentions to continue to use smart watches.

H2. PU will have positive effects on intentions to continue to use smart watches.

H3. PU will have positive effects on ATs toward smart watches.

H4. PEOU will have positive effects on ATs toward smart watches.

H5. PEOU will have positive effects on PU of smart watches.

2.3 AQ

A digital device's AQ is perhaps even more important in human-computer interactions than its utilitarian quality, given that affect (i.e. mood, emotion, feelings) largely determines individual perceptions, cognitions, and behaviors (Zhang and Li, 2004, 2005). Russell (2003) argued that affect is a fundamental and universal human aspect of all emotion-laden events, objects, and places and defined AQ as the degree to which users believe that a stimulus can change one's core affect. Zhang and Li (2004, 2005) elaborated this concept and applied it to decision making in order to explore the effects of technology's hedonic components (e.g. AQ). Since then, much research has demonstrated that AQ indeed has positive effects on the user acceptance of ICT. For example, studies have found that web sites and web-based applications with greater AQ are perceived to be more useful for completing user tasks (Schenkman and Jönsson, 2000; Zhang and Li, 2004, 2005; Sanchez-Franco, 2010). In their study on smartphone adoption, Kim and Sundar (2014) revealed that AQ elicits positive ATs toward using the technology. Extending this literature to smart watches, this study predicts that smart watches' AQ is also likely to play a significant role in decision making and thereby proposes the following hypothesis:

H6. AQ will have positive effects on PU of smart watches.

2.4 RA

Everett Roger's innovation diffusion theory (IDT) is frequently referred to as one of the fundamental frameworks for studying adoption and diffusion in various research fields. IDT explicates how users decide to adopt a new idea, practice, or technology, positing that these decisions are based largely on a set of innovation attributes that lead to subjective beliefs about the innovation (Rogers, 1995; Agarwal, 2000). As one of these attributes, RA has been particularly useful in assessing whether the perceived benefits of using an innovation outweigh the risks (Karahanna *et al.*, 1999; Vishwanath and Goldhaber, 2003). RA suggests that an innovation is adopted more rapidly when it is perceived to be better than the similar idea, product, or practice being superseded or that is currently available. For example, studies have demonstrated that RA has positive effects on the PU of e-learning systems (Lee *et al.*, 2011), mobile virtual network operators (MVNOs) (Shin, 2010), and N-screen services (Shin, 2012a). In accordance with the literature and documented findings, this study predicts a strong correlation between RA and PU in smart watch adoption and proposes the hypothesis below:

H7. RA will have positive effects on PU of smart watches.

2.5 MB and AV

A key strength of mobile devices is their ability to provide a strong sense of expediency and immediacy that lead users to believe that the devices allow them easy, fast, and timely access to information (Kynaslahti, 2003; Huang *et al.*, 2007). Gillick and Vanderhoof (2000) and Pagani (2004) argued that the anywhere-anytime access to content and services offered by MB and AV is the greatest benefit of mobile-based ICT. Specifically, MB represents the "anywhere" characteristic of mobile technology, and it is defined as the degree to which users believe that they can move to different locations and use their devices in transit (Verkasalo, 2008; Shin, 2012b). On the other hand, AV is referred to as the degree to which users believe that their devices offer real-time connectedness to information and services (Shin, 2012b), reflecting mobile technology's "anytime"-ness. Shin (2009,b) argued that AV induces embedded gratifications by allowing users to experience the psychological readiness generated by having access to information at any time.

The significant roles of MB and AV in promoting mobile technology adoption are well-documented. For example, MB was found to be a critical factor in shaping user perceptions of mobile cloud computing (Park and Kim, 2014), LTE services (Park and Kim, 2013), mobile learning (Huang *et al.*, 2007), and social network games (Park *et al.*, 2014), while AV was found to be an important predictor of the adoption of mobile technologies such as wireless broadband internet (Shin, 2007) and digital multimedia broadcasting (Shin, 2009b). Shin (2012b) demonstrated that the MB and AV of the mobile voice over internet protocol network increased the technology's PEOU. By extension, this study predicts that both MB and AV are likely to play a similarly critical role in smart watch adoption, given that providing expedient and immediate access to information is the technology's primary utilitarian purpose. Thus, the following hypotheses are proposed:

H8. MB will have positive effects on PEOU of smart watches.

H9. AV will have positive effects on PEOU of smart watches.

2.6 Subcultural appeal

> While people buy watches to tell time, the number one criterion in choosing a [smart] watch for most people is how it will look. It's a fashion statement, not a technology one (Bajarin, 2014).

As the above excerpt from the *Time* magazine points out, smart watches are viewed not only as time-telling utilitarian tools but also as aesthetic items that express users' individual characters and values. Such phenomena are known to be triggered by a belief that using a certain digital device currently rare in mainstream culture distinguishes its users from the vast majority, which Sundar *et al.* (2014) describe as the subcultural appeal of cool technology. Horton *et al.* (2012) and Southgate (2003) noted that individuals try to be cool, do cool things, and have cool commodities in order to satisfy their desire to be different and express themselves in unique ways. Given that smart watches are still relatively novel and not as common as mainstream devices such as smartphones, they are likely to be perceived as cool items that would promote the subcultural value of the technology. Therefore, the following hypothesis is proposed:

H10. Subcultural appeal will have positive effects on ATs toward smart watches.

2.7 Cost

Do users think that smart watches are expensive or affordable? Are they willing to pay the prices asked for the devices? These practical questions are asked by manufacturers, advertisers, and marketers aiming at the devices' mass penetration because user purchasing behavior and intentions are largely determined by users' perceptions of costs. For example, Luarn and Lin (2005) probed the relationship between the cost and adoption of mobile banking and found that the perceived cost of using the service restricted users' intentions to use it. Similarly, other studies have consistently demonstrated the negative effects of high perceived cost on users' behavioral intentions to use 3G mobile network services, MVNOs (Shin, 2010), and mobile commerce (Hung *et al.*, 2003; Wu and Wang, 2005). In line with these findings, perceived cost of smart watches is included as a variable in our research model and tested with the following hypothesis:

H11. Cost will have negative effects on intentions to continue to use smart watches.

3. Method

An online survey was conducted to assess the proposed psychological determinants of smart watch adoption. Questionnaire items for measuring PEOU, PU, AT, and IU were adopted from previously validated TAM studies (Davis, 1989, 1993; Venkatesh *et al.*, 2003; Kim and Sundar, 2014). Items for assessing AQ and RA were adopted from measures developed by Kim and Sundar (2014) and Karahanna *et al.* (1999), respectively. MB and AV were measured with items adopted from Huang *et al.* (2007) and Shin (2012b). Items assessing SA and CT were adopted from Sundar *et al.* (2014) and Shin (2009a), respectively. The wording of the original questionnaire items was slightly modified to specifically reflect the context of smart watch usage. Results of the reliability test showed that the measurement had strong internal consistency, with Cronbach's α values far greater than 0.7. The complete list of questionnaire items used in this study is reported in the Appendix.

A professional consulting agency administered the survey and collected the responses in South Korea from March to April, 2014. Participants responded to each question on a seven-point Likert scale anchored by 1 ("strongly disagree") and 7 ("strongly agree"). A total of 363 smart watch users participated in the survey, all of whom reported that they owned one of the currently available smart watches (e.g. Fitbit Flex, i'm Watch, Martian Passport Watch, MetaWatch Frame, Nike+ SportWatch GPS, Samsung Galaxy Gear, Sony SmartWatch) for at least a month. The sample consisted of 216 males and 147 females, at an average age of 32.56 (SD = 8.02). Additional demographic information, including period of use and educational level, is reported in Table I.

A confirmatory factor analysis (CFA) and structural equation modeling (SEM) were conducted on the collected data using AMOS 22 statistical software, with a maximum likelihood estimation method. The reliability and validity of the measurements used for the proposed factor structure were examined via CFA, while the strength and direction of the hypothesized causal paths among the constructs were analyzed via SEM.

4. Results

4.1. Measurement model

As summarized in Table II, the CFA results showed the measurement model's fit indices to be well above the minimum values recommended by prior studies (Bentler and Bonett, 1980; Bentler, 1990; Hu and Bentler, 1999; Hair *et al.*, 2010; Kim and Sundar, 2014): ratio of χ^2 to the degrees of freedom (χ^2/df) = 2.285, comparative fit index (CFI) = 0.951, goodness-of-fit index (GFI) = 0.832, normed fit index (NFI) = 0.917, incremental fit index (IFI) = 0.952, Tucker-Lewis index (TLI) = 0.944, parsimony comparative fit index (PCFI) = 0.829,

Table I. Sample demographics

	n (%)
Age	
20-29	143 (39.4)
30-39	135 (37.2)
40-49	83 (22.9)
Over 50	2 (0.6)
Period of use	
4 weeks-3 months	90 (24.8)
3-6 months	179 (49.3)
6 months-1 year	80 (22.0)
Over 1 year	14 (3.9)
Gender	
Male	216 (59.5)
Female	147 (40.5)
Education	
Less than high school	1 (0.3)
High school	27 (7.4)
Undergraduate	294 (81.0)
Graduate	41 (11.3)

Note: $n = 363$

Table II. Fit indices of the measurement and structural models

Fit index	Recommended value	Measurement model	Structural model
χ^2/df	⩽3.00	2.285	2.646
CFI	⩾0.92	0.951	0.936
GFI	⩾0.80	0.832	0.808
NFI	⩾0.90	0.917	0.901
IFI	⩾0.90	0.952	0.936
TLI	⩾0.90	0.944	0.929
PCFI	⩾0.50	0.829	0.844
PGFI	⩾0.50	0.686	0.689
PNFI	⩾0.50	0.799	0.812
RMSEA	⩽0.08	0.060	0.067

Notes: χ^2/df, ratio of χ^2 to the degrees of freedom; CFI, comparative fit index; GFI, goodness-of-fit index; NFI, normed fit index; IFI, incremental fit index; TLI, Tucker-Lewis index; RMSEA, root mean square error of approximation

parsimony goodness-of-fit index (PGFI) = 0.686, parsimony normed fit index (PNFI) = 0.799, and root mean square error of approximation (RMSEA) = 0.060. The measurement model was also found to have robust internal reliability as well as convergent and discriminant validity: the Cronbach's α values were all above 0.70, and the factor loadings of the questionnaire items and average variance extracted (AVE) were over 0.70 and 0.50, respectively (see Table III). The square roots of the AVEs of all observed variables were larger than the inter-correlations between the variables (see Table IV).

4.2 Structural model and hypothesis test

The SEM results indicated that the structural model had satisfactory levels of fit indices (see Table II): χ^2/df = 2.646, CFI = 0.936, GFI = 0.808, NFI = 0.901, IFI = 0.936, TLI = 0.929,

Construct	Item	Internal reliability Cronbach's α	Item-total correlation	Convergent and discriminant validity Factor loading	Composite reliability	Average variance extracted
Attitude	AT1	0.946	0.866	0.926	0.961	0.862
	AT2		0.873	0.930		
	AT3		0.901	0.946		
	AT4		0.843	0.911		
Intention to continue to use	IU1	0.935	0.824	0.919	0.959	0.887
	IU2		0.907	0.961		
	IU3		0.872	0.945		
Perceived ease of use	PE1	0.894	0.773	0.898	0.934	0.825
	PE2		0.810	0.918		
	PE3		0.792	0.909		
Perceived usefulness	PU1	0.962	0.887	0.928	0.971	0.869
	PU2		0.896	0.934		
	PU3		0.897	0.935		
	PU4		0.898	0.936		
	PU5		0.887	0.929		
Affective quality	AQ1	0.891	0.761	0.893	0.933	0.823
	AQ2		0.779	0.902		
	AQ3		0.828	0.927		
Relative advantage	RA1	0.937	0.839	0.927	0.960	0.889
	RA2		0.892	0.953		
	RA3		0.882	0.949		
Mobility	MB1	0.902	0.772	0.896	0.939	0.837
	MB2		0.845	0.935		
	MB3		0.803	0.913		
Availability	AV1	0.929	0.801	0.887	0.950	0.825
	AV2		0.861	0.925		
	AV3		0.837	0.910		
	AV4		0.839	0.911		
Subcultural appeal	SA1	0.941	0.809	0.878	0.955	0.810
	SA2		0.884	0.929		
	SA3		0.854	0.910		
	SA4		0.846	0.903		
	SA5		0.809	0.878		
Cost	CT1	0.716	0.654	0.894	0.906	0.762
	CT2		0.674	0.903		
	CT3		0.600	0.820		

Table III. Internal reliability and convergent validity of the measurements

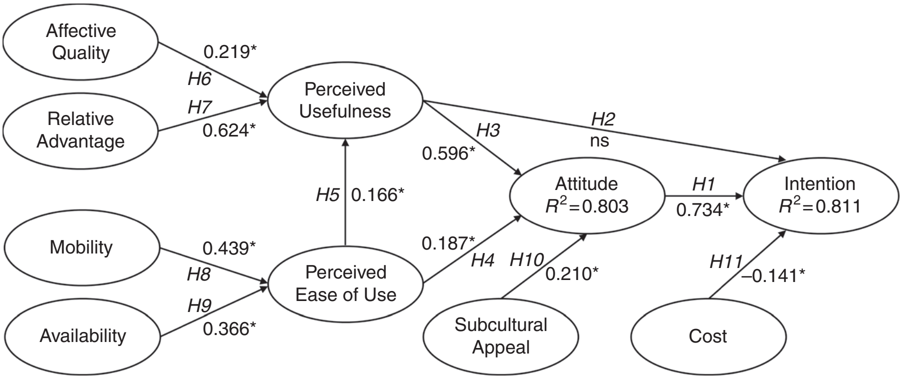
PCFI = 0.844, PGFI = 0.689, PNFI = 0.812, and RMSEA = 0.067. As depicted in Figure 1 and Table V, the structural model revealed that the standardized coefficients of all proposed paths were significant, except for the PU→IU path (*H2*, $\beta = 0.114$, $p = 0.079$).

Consistent with *H1* and *H11*, AT (*H1*, $\beta = 0.734$, $p < 0.001$) and cost (*H11*, $\beta = -0.141$, $p < 0.001$) were associated with intentions to continue to use the smart watch, such that a more positive AT led to a greater intention, while higher perceived cost had a negative effect on user intention. As predicted in *H3*, *H4*, and *H10*, PU (*H3*, $\beta = 0.596$, $p < 0.001$), ease of use (*H4*, $\beta = 0.187$, $p < 0.001$), and subcultural appeal (*H10*, $\beta = 0.210$, $p < 0.001$) had positive effects on ATs toward the smart watch.

Constructs	Mean (SD)	AT	IU	PE	PU	AQ	RA	MB	AV	SA	CT
AT	4.99 (1.13)	*0.928*									
IU	4.97 (1.15)	0.680	*0.942*								
PE	5.03 (0.99)	0.527	0.497	*0.908*							
PU	4.69 (1.12)	0.634	0.598	0.496	*0.932*						
AQ	4.82 (1.13)	0.635	0.615	0.416	0.577	*0.907*					
RA	4.67 (1.17)	0.588	0.531	0.414	0.695	0.584	*0.943*				
MB	5.30 (1.05)	0.623	0.609	0.503	0.503	0.526	0.483	*0.915*			
AV	4.84 (1.06)	0.663	0.620	0.497	0.619	0.614	0.591	0.549	*0.908*		
SA	4.77 (1.08)	0.539	0.591	0.463	0.545	0.543	0.480	0.473	0.534	*0.900*	
CT	4.93 (0.83)	0.385	0.404	0.349	0.377	0.364	0.355	0.380	0.404	0.430	*0.873*

Notes: AT, attitude; IU, intention to continue to use; PE, perceived ease of use; PU, perceived usefulness; AQ, perceived affective quality; RA, relative advantage; MB, mobility; AV, availability; SA, subcultural appeal; CT, cost. Diagonal elements in italics represent the square roots of the average variance extracted

Table IV. Descriptive analysis and discriminant validity of the measurements



Note: $*p<0.001$

Figure 1. User experience model

Hypotheses	Standardized coefficient	SE	CR	Supported
H1: AT→IU	0.734*	0.073	10.519	Yes
H2: PU→IU	0.114	0.067	1.757	No
H3: PU→AT	0.596*	0.050	11.709	Yes
H4: PE→AT	0.187*	0.048	4.390	Yes
H5: PE→PU	0.166*	0.041	4.687	Yes
H6: AQ→PU	0.219*	0.056	3.827	Yes
H7: RA→PU	0.624*	0.051	11.059	Yes
H8: MB→PE	0.439*	0.067	5.859	Yes
H9: AV→PE	0.366*	0.065	4.994	Yes
H10: SA→AT	0.210*	0.039	5.076	Yes
H11: CT→IU	−0.141*	0.043	−4.101	Yes

Note: $*p < 0.001$

Table V. Summary of hypothesis tests

Furthermore, *H5*, *H6*, and *H7* were also supported by the results. PEOU (*H5*, $\beta = 0.166$, $p < 0.001$), affect quality (*H6*, $\beta = 0.219$, $p < 0.001$), and RA (*H7*, $\beta = 0.624$, $p < 0.001$) emerged as significant determinants of the PU of the smart watch. As hypothesized in *H8* and *H9*, both MB (*H8*, $\beta = 0.439$, $p < 0.001$) and AV (*H9*, $\beta = 0.366$, $p < 0.001$) were positively associated with the device's PEOU.

5. Discussion

As consumer interest in smart watches has recently become apparent, increasing emphasis has been placed on the factors that enable a more positive user experience and promote greater user acceptance of the technology. Accordingly, this study explores smart watches' key psychological quality factors and investigates how they contribute to smart watch adoption by proposing and validating an integrated user acceptance model. The model demonstrates that smart watches with greater MB and AV are perceived to be easier to use, while those with greater AQ and RA are believed to be more useful; together, these attributes lead to a positive AT and ultimately a greater intention to continue to use smart watches. The model's overall explanatory power is found to be relatively high, accounting for 80 percent of the variance in user AT and 81 percent in intention.

This study's main contribution is its successful identification and integration of the affective factors (i.e. AQ, SA) of smart watches. Although the cognitive and rational evaluation of technology has long been the focus of user acceptance studies (Venkatesh *et al.*, 2003; Zhang and Li, 2004, 2005), affective qualities are increasingly being seen as equally influential determinants of adoption. This is especially true for wearable devices, as they are considered not only utilitarian tools but also personalized, trendy items that reflect individual identities, emotions, and aesthetic values, as confirmed by the significant path coefficients obtained from AQ to PU ($\beta = 0.219$, $p < 0.001$) and SA to AT ($\beta = 0.210$, $p < 0.001$). A practical implication of this finding is that emphasis should be placed on both engineering (e.g. cognitive, technological aspects) and design (e.g. affective, aesthetic aspects) in order to provide a more accessible, unobtrusive user experience (Defeo, 2013).

Another contribution of this study is the two-dimensional conceptualization of the anywhere-anytime accessibility to information in terms of MB and AV. Most research on the user acceptance of mobile technologies and services have investigated MB as a single-dimensional concept (e.g. Huang *et al.*, 2007; Verkasalo, 2008; Mallat *et al.*, 2008; Park and Kim, 2013, 2014), thus ignoring the differences caused by the sense of portability and real-time connectedness induced by MB and AV, respectively. For example, a MacBook Air may have decent MB, as it can be easily carried by users in transit, but it may not have as good an AV as the iPhone, since users must go through the start-up process to use it. As this example illustrates, MB and AV are similar but fundamentally different concepts that simultaneously influence the adoption of technology, as verified by the significant path coefficients obtained from MV to PE ($\beta = 0.439$, $p < 0.001$) and AV to PE ($\beta = 0.366$, $p < 0.001$).

As in much of the prior research, this study used the TAM framework to demonstrate that PEOU, PU, and AT are significant predictors of user intentions to continue to use smart watches, thereby extending TAM's applicability to the wearable computing context. However, the study's greater theoretical contribution is its integration of the affective (i.e. AQ, SA), rational (i.e. MB, AV, CT), and usability (i.e. PE, PU) factors in a single research model. Extended TAM frameworks that integrate both the affective and rational qualities of technology are believed to be more effective in explicating technology adoption than is the original, unmodified TAM (Chun *et al.*, 2012; Kim and Sundar, 2014).

Therefore, the proposed research model is likely to have greater explanatory power than the traditional TAM.

Shin (2010) called for more research on the context-specific (as opposed to generic) behaviors around certain technologies. This study responds by highlighting users' affective responses to wearable technologies and identifying the essential role they play in guiding PU and ATs. Our findings provide a solid basis for the industrial development of an evaluation framework for the adoption of new wearable technologies. AQ and cultural factors appear to be essential in determining the success or failure of wearable computing, a practical insight helpful for engineers and designers seeking to increase the use of wearable devices.

The non-significant relationship between PU and IU ($\beta = 0.114$, $p = 0.079$) and the relatively small path coefficients from CT to IU ($\beta = -0.177$, $p < 0.001$) are also noteworthy findings. The non-significant path suggests that the indirect effects of PU on IU via AT might have reduced the direct effects of PU on IU. The mean age (32.56) of the survey respondents was higher than that of the typical college-aged samples, implying that our sample might represent the early-adopter group (with greater financial resources) who were willing to purchase smart watches regardless of their cost.

This study has several limitations that should be addressed in future research. First, the absence of individual differences as control variables might have reduced the exploratory strength of our findings. Given that gender and race are known to affect the intensity and nature of ICT usage (Jackson *et al.*, 2008), controlling for these differences could have increased the validity of the proposed research model. Second, the implications of our findings may not be generalizable to more diverse populations. Since smart watch adoption is still in the nascent stage, the survey respondents are likely to be early adopters or power users who are more self-motivated to purchase and experiment with novel technology than are mainstream consumers. These technologically efficacious individuals are often classified as visionaries, risk-takers, and technophiles; they tend to have greater expertise with and interest in adopting new technologies, engage in multitasking, and explore the potential of new technologies (Moore, 1991; Sunder and Marathe, 2010). Therefore, the relatively weak effects of PEOU could be attributable to respondents' confidence that they have skills needed to use smart watches, suggesting the need to investigate the moderating effects of the adopter group or power usage in wearable technology adoption. Collecting domestic data in South Korea could also have reduced the applicability of the findings to other countries.

While the adoption of other popular wearable devices (e.g. smart glasses, healthcare bracelets) may be influenced by antecedents similar to those explored in this study, some unexamined device-specific variables may induce unique psychological effects; thus, our research model may not have sufficient validity to comprehensively predict user acceptance of wearable technology in general. Future studies on related topics should therefore extend our findings by investigating the role of control variables using data collected from diverse, international samples, and identifying additional antecedents of wearable technology adoption.

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Appendix. Questionnaire items

Attitude (Venkatesh *et al.*, 2003)

AT1: using this smart watch is a good idea.

AT2: I have a generally favorable attitude toward using this smart watch.

AT3: I like the idea of using this smart watch.

AT4: overall, using this smart watch is beneficial.

Intention to use (Venkatesh *et al.*, 2003)

IU1: I predict I will use this smart watch in the future.

IU2: I plan to use this smart watch in the future.

IU3: I expect my use of this smart watch to continue in the future.

Perceived ease of use (Davis, 1989, 1993)

PE1: operating this smart watch is easy for me.

PE2: I find this smart watch easy to use.

PE3: using this smart watch does not require a lot of my mental effort.

Perceived usefulness (Davis, 1989, 1993)

PU1: using this smart watch helps me productively complete my tasks.

PU2: using the smart watch helps me effectively do my job.

PU3: this smart watch is useful in doing my job.

PU4: using this smart watch improves my ability to complete my tasks.

PU5: using this smart watch makes it easier to complete my tasks.

Affective quality

AQ1: I feel excited when using this smart watch.

AQ2: I would miss using this smart watch if I no longer have it.

AQ3: this smart watch is attractive and pleasing.

Relative advantage (Karahanna *et al.*, 1999)

RA1: using this smart watch improves the quality of my work.

RA2: the advantages of using this smart watch outweigh the disadvantages.

RA3: this smart watch has greater advantages and offers more functions than its precursors.

Mobility (Huang *et al.*, 2007)

MB1: this smart watch has good mobility.

MB2: I feel I can use this smart watch anywhere.

MB3: I would like to use this when I am in transit from one place to another.

Availability (Shin, 2012b)

AV1: I can access information and desired contents any time via this smart watch.

AV2: I can use this smart watch any time I want to get desired information and service.

AV3: this smart watch offers the sense of real-time connectedness.

AV4: this smart watch offers immediate, timely access to information or service I need.

Subcultural appeal (Sundar *et al.*, 2014)

SA1: this smart watch makes people who use it different from other people.

SA2: If I use this smart watch, it would make me stand apart from others.

SA3: this smart watch helps people who use it stand apart from the crowd.

SA4: people who use this smart watch are unique.

SA5: people who use this smart watch would be considered leaders rather than followers.

Cost (Shin, 2009a)

CT1: this smart watch was expensive.

CT2: purchasing this smart watch was a burden to me.

CT3: I was able to easily afford this smart watch.

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