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Consumers' Acceptance of Smart Clothing
-A Comparison between Perceived Group and Non-Perceived Group-

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Abstract

This study explains the consumer acceptance of smart clothing using the extended Technology Acceptance Model (TAM); in addition, it compares the difference in the path hypotheses of the perceived group and non-perceived group from the aspect of the extended TAM. A total of 815 copies of questionnaire were collected from a web-based survey in March 2009. Structural equation modeling was used to examine the entire pattern of intercorrelations among the constructs and to test related propositions using an AMOS 5.0 package. The fitness of the extended TAM explains the process of the adaptation of smart clothing. Technology Innovation (TI) and Clothing Involvement (CI) were confirmed as antecedent variables to affect TAM. In the perceived group, Technology Innovation (TI) and Clothing Involvement (CI) showed significant impacts on the Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) while Technology Innovation (TI) did not influence the Perceived Ease of Use (PEOU) in the non-perceived group. Perceived Ease of Use (PEOU) influenced the Perceived Usefulness (PU) and indirectly influenced Attitude (A) through the Perceived Usefulness (PU) in both groups. In addition, Perceived Usefulness (PU) did not influence Acceptance Intention (AI) but indirectly affected Acceptance Intention (AI) through Attitude (A). Therefore, Attitude (A) was found to be an important parameter in the adaptation of smart clothing in both groups. This finding implies that consumers first perceive the usefulness of smart clothing, then take favorable attitudes towards the smart clothing, and finally have the intention to adopt it. Strategies for publishing and informing consumers of the functions of smart clothing and usefulness in life are necessary; in addition, understanding what useful values they expect from the clothing is also crucial.

Key words: Technology Acceptance Model (TAM), Technology Innovation (TI), Clothing Involvement (CI)

I. Introduction

Our lifestyle is rapidly being digitalized, and various contents are being developed accordingly because of the development of information technology. The same is true for clothing. Smart clothing products reflecting digital technology are being launched in the market. They are a new type of clothing with high value-added since they boast of new functions such as the detection of physical condition and external environment of the wearer.

Smart clothing is being developed for various areas depending on the purpose of the users. MP3-playing and biochemical-sensing clothes have entered the commercialization stage worldwide. Recently, smart clothes equipped with these functions have begun to be sold in the Korean market. Although the US captured the biggest market share in smart clothing in the world in 2007, its growth rate of 19% was far lower than Asia-Pacific region's 49.2%. Korea is expected to account for 50% of the world's smart textile and clothing market by 2015.

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Studies on consumers' response to and acceptance of smart clothing began to be introduced alongside the beginning of its commercialization. Since the clothing carries innovative IT functions, most of the studies applied the Technology Acceptance Model (TAM) that has been frequently used for the analysis of consumers' intention to accept innovative technology (Chae, 2009; Kang & Jin, 2007; Lee, 2008). Kang and Jin (2007) asserted that technology innovation and fashion innovation wield an influence on the acceptance of smart clothing. Lee (2008) explained the TAM with the addition of perceived values. Finally, Chae (2009) proved that clothing involvement has an impact when consumers accept smart clothing.

Currently, the commercialization of smart clothing applying IT technologies that have been researched on and developed to date is in progress. As such, now is the right time to come up with marketing strategies or ideas for dealing with realistic issues that may arise to penetrate the mainstream fashion market. Therefore, this study sought to contribute to the establishment of effective commercialization strategies through the investigation of antecedent variables affecting consumers' acceptance of smart clothing and through analysis as to whether there is any difference in the process of acceptance depending on consumers' perception of smart clothing.

II. Literature Review

1. Development of Smart Clothing

Depending on the purpose of users, smart clothing is being developed for various areas: entertainment, leisure sports, health and medical supplements, and military and special purposes (Park & Lee, 2001). In fact, it has entered the commercialization stage worldwide.

Among the smart clothing products, MP3-playing clothes for entertainment were first commercialized, thanks to technological development and commercial advantages. Burton Snowboards, an American company, first released in 2005 a snowboard jacket carrying the functions of an MP3-player and a mobile phone for sending and receiving calls. Later, Levi's, O'neill, Zegna, Kenpo, etc., have steadily launched products (Cho et al., 2006). Meanwhile, Korean companies such as Beaucre Merchandising Co., FnC, Kolon, etc., have developed and released MP3-playing clothes since 2007.

Smart clothing developed for health and medical purposes is in the form of sensing clothes. Whereas MP3-playing clothes are being launched in markets by a number of global brands, sensing ones are being produced by a handful of sports outfit companies. In 2006, Adidas, a German sportswear company, launched sports shirts with sensors attached to monitor the heart rate, sports shoes that measure the quantity of motion through built-in sensors, and kits that can transmit information wirelessly to watch-like displays (www.polar.fi/en). NuMetrex sports bras from Textronics, which is a merger between Adidas and Bioharness of Zaphyr, are representative cases of commercialization of smart clothing. The development of sensing sportswear seems to be accelerated further by the recently growing interest in health and fitness and progress of sensing technology and wireless information technology.

As newly emerging smart clothing, photonic clothes are the generic term for all clothes that illuminate through devices (Cho et al., 2006). Marmot succeeded in producing jackets that electrically glow in the dark for ski guides or mountain rescuers. Land's End produced jackets and bags that partly illuminate for the safety of children.

According to a report by Venture Development Corporation (2005), a globally renowned technology consulting company, the wearable system is largely classified into 4 types (belt and headgear type, wrist and finger gear type, clothes type, etc.), 6 markets, and 7 applications smart clothing falls into the clothes type, and its future seems to be bright especially in the bio-monitoring market. According to a report issued by Parks Associates in 2006 titled "Delivering Quality Healthcare to the Digital Home," the sales of home and healthcare service in the US are forecast to grow by almost five times within 5 years to USD 2.1 billion by 2010 (www.parksassociates.com).

Digital functions and devices will become more diverse, with majority of the general public likely to wear or carry them in daily life. Accordingly, consumers' interest in and demands for smart clothing combining digital functions will steadily grow, and its significance will most likely rise from the industrial and technological perspectives.

2. Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), proposed by Davis (1989) has been a widely cited model for predicting and explaining the adoption process of information technology. TAM posits that two particular variables, perceived ease of use and perceived usefulness are primary relevance for consumers' adoption of innovative technology. Perceived Ease of Use (PEOU) is defined as the degree to which user expects the system or products to be free of efforts. Perceived Usefulness (PU) refers to the user's subjective probability that using a specific application system or products will increase his or her job performance. PEOU and PU are proved as the antecedent variables that affect the Attitudes (A) of users: A in turn affect Adoption Intention (AI) in acceptance of information technology.

As acceptance for TAM has grown through many of the past studies, so too has a research need to improve upon it. Other studies have extended TAM (Fig. 1) by inputting external variables such as intrinsic motivation, control emotion, normative beliefs, and so on according to applied system or product types (Agarwal & Karahanna, 2000; Agarwal & Prasad, 1999; Chen et al., 2002; Igbaria et al., 1997; Jackson et al,. 1997; Tan & Teo, 2000; Venkatesh & Morris, 2000). Agarwal and Prasad (1999) found support for their hypothesis that the innovation characteristics that influence initial use of the World Wide Web (WWW) differ from those characteristics that impact intentions to continue using it. Chen et al. (2002) tested the extended TAM that included compatibility and made a case for its inclusion for explaining consumer attitudes towards shopping at virtual stores. Tan and Teo (2000) also used innovation characteristics but in the context of explaining user's adoption of internet banking. Their study showed that perceptions about the innovation and perceived behavioral control were significant predictors of intentions to adopt on-line banking services.

Studies that explain consumers' acceptance of smart clothing using TAM were published in Korea as well. Kang and Jin (2007) employed TAM as a theoretical framework and analyzed consumers' intention of purchase by adding variables, technology innovation and fashion innovation to TAM. Lee (2008) extended TAM by adding perceived value factors. Chae (2009) investigated consumer's acceptance of smart clothing using the extended TAM. Besides perceived ease of use and perceived usefulness, clothing involvement was included as an antecedent variable in explaining the appropriateness of the extended TAM.

III. Research Model and Hypotheses

The purpose of this research is to explain consumers' attitudes and purchase intention in the adoption of smart clothing using the TAM presented by Davis (1989). TAM has been regarded as highly explanatory as well as the clearest model in explaining consumers' adoption of innovative technology or products. Existing studies extended the model by adding related external variables to improve the explanation depending on the type and field of innovative technology

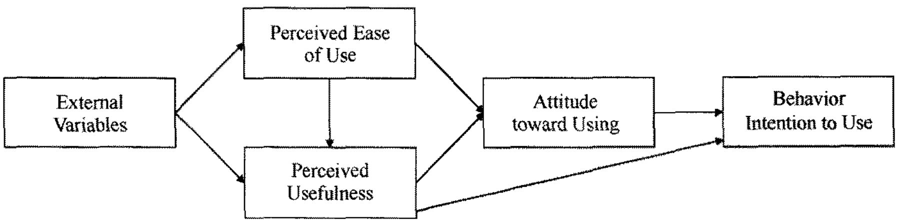

Fig. 1. Extention of Technology Acceptance Model (TAM).

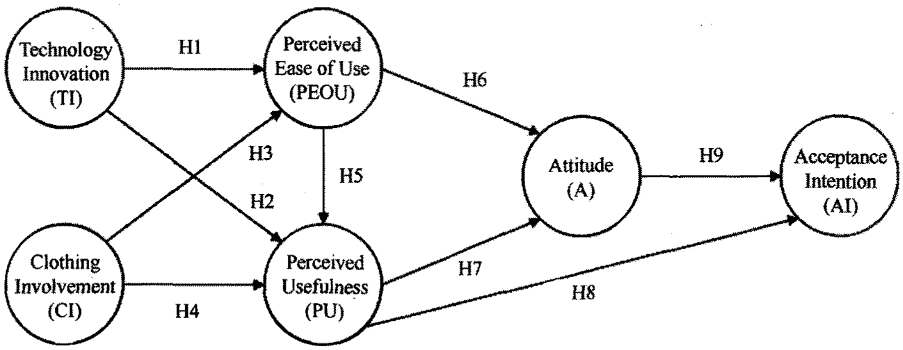

Fig. 2. Research model and hypotheses.

(Agarwal & Karahanna, 2000; Agarwal & Prasad, 1999; Venkatesh, 2000; Vijayasarathy, 2004). To explain consrumers' adoption of smart clothing, this research extended TAM by adding two more variables -- consumers' technology innovation and clothing involvement -- considering the feature of smart clothing which is combined with innovative technology. The detailed research objectives are as follows:

1. To extend TAM to explain the adoption process of smart clothing.
2. To compare the difference in the path hypotheses of the perceived group and non-perceived group from the aspect of the extended TAM.

The research model and path hypotheses are shown in <Fig. 2>.

1. Effects of Technology Innovation (TI) on the Perceived Ease of Use (PEOU) and Perceived Usefulness (PU)

Midgley and Dowling (1978) defined innovation as the level of sensitivity of an individual to a new idea and an innate personality. Goldsmith and Hofacker (1991) referred to it as the intention to try a new thing. An individual's innovative inclination has great effects on his/her Adoption and Adoption speed of a new technology (Foxall, 1988; Gatignon & Robertson, 1985). According to Taylor and Todd (1995), innovative people try harder to obtain more information on new things than their counterparts; as a result, they retain more knowledge and capacities and solve more easily the complicated issues arising from the Adoption process of the innovation. Based on these research results, one who retains high innovation can be expected to have active reactions to new technology or products, perceive usefulness in the information-gathering process, and show stronger will to address the complexity of use easily.

H1: Technology Innovation will affect Perceived Ease of Use.

H2: Technology Innovation will affect Perceived Usefulness.

2. Effects of Clothing Involvement (CI) on the Perceived Ease of Use (PEOU) and Perceived Usefulness(PU)

Involvement is generally accepted as a person's motivational state (i.e., arousal, interest, drive) toward an object where such motivational state is activated by the relevance or importance of the object in question (Mittal, 1989). Clothing involvement is the state of interest in clothing, showing how much consumers are interested in clothing and how important clothing is for them. Since consumers are expected to perceive smart clothing as a fashion product rather than as innovative technology in accepting the clothing, clothing involvement measuring the interest and importance of clothing was presumed to be a critical variable based on the extended TAM. According to Kaiser (1990), consumers with high interest in clothing spend much of their time, money, and energy on outfits and appearances. Therefore, consumers with high clothing involvement will actively search for information driven by their high interest in products, use the product easily, and subsequently take more positive attitudes toward the usefulness of the product.

H3: Clothing Involvement will affect Perceived Ease of Use.

H4: Clothing Involvement will affect Perceived Usefulness.

3. Effects of Perceived Ease of Use (PEOU) on Perceived Usefulness (PU) and Attitudes (A)

Perceived ease of use refers to the expected level at which users can use a targeted system without making great efforts. Davis (1989) assumed that the perceived ease of use had indirect effects on the intention or behaviors to accept a new thing without any direct impact since it affected the attitudes and intention to accept through perceived usefulness. Moreover, Davis (1989) clarified that the perceived ease of use was an antecedent variable of perceived usefulness; the relationship between the two variables was confirmed by McFarland's research (1999) on behaviors in the use of computers and Ruth's study (2000) on web-shopping behaviors.

Davis et al. (1989) believed that the perceived ease of use had direct impacts on attitudes as well as indirect impacts on attitudes through perceived usefulness. A number of studies found that the perceived ease of use had direct impacts on perceived usefulness and indirect effects on attitudes through perceived usefulness (Igbaria et al., 1997; Mathieson, 1991; Szajna, 1994).

H5: Perceived Ease of Use will affect Perceived Usefulness.

H6: Perceived Ease of Use will affect Attitude toward smart clothing.

4. Effects of Perceived Usefulness (PU) on Attitudes (A) and Acceptance Intentions (AI)

Perceived usefulness is a subjective notion of users expecting innovative products or technology to be more useful than existing ones and helpful in improving their job performances. Perceived usefulness wields direct impacts on the attitudes to adopt a system; at the same time, it directly affects the intention to accept the system (Adams et al., 1992; Chen, 2000; Davis, 1989). Davis et al. (1989) believed that positively perceived beliefs influenced the attitudes of individuals, and that perceived ease of use was the most critical variable having direct influence on the attitudes and intention of users to adopt novel things. Ruth (2000) presented an analysis result, i.e., perceived usefulness had direct impacts on web-shopping behaviors. In their research on web-using behaviors using TAM with attitudes excluded, Agarwal and Karahanna (2000) reported that perceived usefulness had effects on the intention to use the Internet.

H7: Perceived Usefulness will affect Attitude toward smart clothing.

H8: Perceived Usefulness will affect Acceptance Intention toward smart clothing.

5. Effects of Attitudes (A) on Acceptance Intention (AI)

Attitudes refer to individual inclinations, i.e., an individual likes or hates a certain subject (Engel et al., 1995) and feelings or evaluative reactions toward the subject. Most research using TAM found that attitudes of using information technology or system had direct influence on the behaviors to use them (Adams et al., 1992; Davis, 1989; Mathieson, 1991; Szajna, 1994). Some TAMs wherein the variable "attitudes" was eliminated resulted in a belief structure, i.e., the perceived ease of use and perceived usefulness had direct impacts on behaviors to use innovative things (Agarwal & Karahanna, 2000; Davis et al., 1989; Ruth, 2000; Venkatesh & Davis, 1996). Since smart clothing had not been actively commercialized, and gaps between the attitudes of consumers and intention to purchase were expected, attitudes were used as a parameter in this study.

H9: Attitude will affect Acceptance Intention toward smart clothing.

IV. Methods

1. Measurement

For this study, a survey was conducted featuring questions on the perception of smart clothing, technological innovation, clothing involvement, perceived ease of use, perceived usefulness, attitudes, and demographic characteristics. To divide perceived group and non-perceived group for smart clothing, respondents were asked whether they have heard of or seen smart clothing at least once. Referring to the research of Agarwal and Karahanna (2000), 5 questions on technology innovation were prepared to ask respondents regarding their will to perceive new products and adopt and purchase them. To examine the aspects of clothing involvement, 5 questions were selected to measure respondents' interests as well as the appreciation for and significance and importance of clothing and method of accumulating knowledge of the products referring to the research of Kim (1999). For the perceived ease of use, which measures the level at which users expect a specific system to be easy to use, 4 questions were drafted by referring to the research of Agarwal and Karahanna (2000) and Venkatesh (2000). For the perceived usefulness to estimate the level at which users expect the use of a certain system to be helpful and efficient in carrying out their jobs, 5 questions were prepared after the correction of this study by referring to the research of Agarwal and Karahanna (2000) and Venkatesh (2000). Attitudes were assessed to find out the preference levels vis-a-vis smart clothing, and 3 questions were drafted by referring to the research of Fishbein (1963) and Chattopadhyay and Basu (1990). In terms of acceptance intention to identify whether respondents have intention to buy smart clothing, 3 questions were prepared by referring to the research of Agarwal and Karahanna, 2000). All questions were measured using a 7-point Likert Scale ranging from "strongly disagree" (1) to "strongly agree" (7).

Questions to identify respondents' perceived ease of use, perceived usefulness, attitudes, and acceptance intention were answered after presenting the stimuli of smart clothing; they involved presenting more than two types of photos of MP3-playing jackets, sensing sportswear, and photonic clothes together with an explanation of their functions and operation method. To exclude the effects of perception of certain brands, their brand names were not indicated.

2. Sample and Data Analysis

Using panels of specialized Internet research institutions nationwide, adults over 20 years old and residing in Seoul and its satellite cities and metropolitan cities nationwide were selected through convenience sampling; 815 effective samples collected on March 2009 were used for the analysis. Among them, 469 persons (65.9%) were grouped into a perceived group that has heard of or seen smart clothing at least once; the remaining 346 persons (34.1%) were classified into a non-perceived group that has never heard of or seen smart clothing. The sample features of the perceived group and its counterpart are shown in <Table 1>.

To verify the path of accepting smart clothing, a covariance structure model was built. AMOS 5.0 package was used.

V. Results and Discussion

1. Validity and Reliability of Elements of the Research Model

To eliminate the factors that deter conformity of unidimensionality presented in this study, a Confirmatory Factor Analysis (CFA) was performed for each constituting factor. As a result, the CR (Critical Ratio) values of all question items consisting of the factors stood at more than 2 and around the level of $p<.001$; the estimated values of parameters were more than twice the standard errors. This suggests the fairly high fitness of the model. Cronbach's Alpha of the model was analyzed to confirm the reliability of measurements. As a result, the reliability of all factors involved in the model was more than 0.9, a very satisfying level. The convergent validity and reliability of the factors are shown in <Table 2>–<Table 3>.

2. Research Model Fitness

To verify the fitness of the extended TAM, AMOS 5.0 was used for the analysis. Generally, since the Chi-square test is sensitive to the sample size, using it as a reference indicator is recommended but not as

Table 1. Demographic characteristics

Variables	Items	Group (%)		Total
		Perceived group	Non-Perceived group	
Age	20-29	165 (35.2)	117 (33.8)	282
	30-39	206 (43.9)	144 (41.6)	350
	40-49	69 (14.7)	70 (20.2)	139
	50 and over	29 (6.2)	15 (4.3)	44
	Total	469 (100)	346 (100)	
Gender	Male	225 (48.0)	158 (45.7)	383
	Female	244 (52.0)	188 (54.3)	432
	Total	469 (100)	346 (100)	
Education	High school	45 (9.6)	70 (20.2)	115
	College	74 (15.8)	46 (13.0)	120
	University	301 (64.2)	195 (56.4)	496
	Advanced degree	49 (10.4)	35 (10.1)	84
	Total	469 (100)	346 (100)	
Occupation	No job	19 (4.1)	21 (6.1)	40
	Housewife	59 (12.6)	45 (13.0)	104
	Student	65 (13.9)	52 (15.0)	117
	Sales & Service worker	35 (7.5)	27 (7.8)	62
	Office worker	193 (41.2)	139 (40.2)	332
	Specialist	74 (15.8)	48 (13.9)	122
	Management	10 (2.1)	6 (1.7)	16
	Others	14 (3.0)	8 (2.3)	22
	Total	469 (100)	346 (100)	
Monthly Income	Less than 2 million	91 (19.4)	87 (25.2)	178
	2-less than 3 million	121 (25.8)	99 (28.6)	220
	3-less than 4 million	90 (19.2)	70 (20.2)	160
	4-less than 6 million	104 (22.2)	65 (18.8)	169
	6-less than 8 million	63 (13.4)	25 (7.2)	88
	Total	469 (100)	346 (100)	

a statistical amount for verification if the sample size is big enough and the verification target model has enough theoretical background (Byrne, 2001).

Therefore, the conformity of the model was verified by comprehensively considering GFI (Goodness-of-Fit: 0.9 or more desirable), AGFI (Adjusted Goodness-of-Fit: 0.9 or more desirable), NFI (Normed Fit Index: 0.9 or more desirable), and RMR (Root Mean Square Residual: 0.05 or less desirable) in this study. The perceived group recorded χ^2=987.9 (df=289, p=.000), GFI=0.841, AGFI=0.807, NFI=0.919, and RMR=0.067, which could be considered satisfactory. For the non-perceived group, χ^2=873.6 (df=289, p=.000), GFI=0.821, AGFI=0.783, NFI=0.904, and RMR=0.105; its AGFI was somewhat lower than the others. The conformity of the non-perceived group was also comparatively lower than its counterpart but remained acceptable when the sample size was considered.

3. Verification of Path Hypothesis

The path model of the perceived group and non-perceived group for smart clothing is presented in

Table 2. Results of the confirmatory factor analysis

Factors	Question Items	Estimated Values	Standardized Estimates	Standard Errors (SE)	Critical Ratios (CR)	Significance (P)	Fitness
Technology Innovation (TI)	TI1	0.908	0.857	0.026	34.857	***	χ^2=77.4 (df=5, p=.000) GFI=0.963 AGFI=0.888 NFI=0.977 RMR=0.042
	TI2	0.993	0.897	0.026	38.440	***	
	TI3	1.000	0.900				
	TI4	0.901	0.810	0.029	31.122	***	
	TI5	0.922	0.814	0.029	31.403	***	
Clothing Involvement (CI)	CI1	0.966	0.878	0.026	36.691	***	χ^2=40.3 (df=5, p=.000) GFI=0.982 AGFI=0.946 NFI=0.988 RMR=0.023
	CI2	0.979	0.897	0.025	38.487	***	
	CI3	0.875	0.839	0.026	33.322	***	
	CI4	1.000	0.897				
	CI5	0.858	0.811	0.028	31.180	***	
Perceived Ease of Use (PEOU)	PEOU1	0.908	0.837	0.025	36.034	***	χ^2= 24.8 (df=2, p=.000) GFI=0.984 AGFI=0.921 NFI=0.992 RMR=0.018
	PEOU2	0.918	0.889	0.022	42.002	***	
	PEOU3	0.939	0.894	0.022	42.624	***	
	PEOU4	1.000	0.938				
Perceived Usefulness (PU)	PU1	0.938	0.888	0.025	37.327	***	χ^2= 124.8 (df=5, p=.000) GFI=0.940 AGFI=0.820 NFI=0.965 RMR=0.041
	PU2	0.928	0.897	0.024	38.174	***	
	PU3	1.000	0.893				
	PU4	0.865	0.817	0.027	31.471	***	
	PU5	0.868	0.843	0.026	33.484	***	
Attitudes (A)	A1	0.998	0.928	0.023	43.279	***	χ^2=0 (df=0, p=.000) GFI=1.000 AGFI=1.000 NFI=1.000 RMR=0.000
	A2	1.000	0.944				
	A3	0.853	0.808	0.026	32.719	***	
Adoption Intention (AI)	I1	0.989	0.919	0.028	35.464	***	χ^2=0 (df=0, p=.000) GFI=1.000 AGFI=1.000 NFI=1.000 RMR=0.000
	I2	0.918	0.858	0.028	32.517	***	
	I3	1.000	0.880				

***p<.001

Table 3. Reliability of constituting factors

Constituting Factors	Number of Questions	Cronbach's Alpha
TI	5	0.932
CI	5	0.937
PEOU	4	0.938
PU	5	0.938
A	3	0.921
AI	3	0.915

<Fig. 3>–<Fig. 4>, respectively. The results of hypotheses verification are shown in <Table 4>.

1) The Perceived Group for Smart Clothing

The path hypotheses with regard to the extended TAM of the perceived group were tested. This study examined the hypotheses of path model between constituting concepts utilizing CR, an indicator equivalent to a general t value to determine dismissal or adoption in the AMOS analysis. In other words, based on the fact that the value was derived by dividing the path coefficients with their standardized errors, they could be regarded as normal distribution if the sample was big enough. If the t value was more than 1.96, causal relationship seemed to exist. As a result, 7 out of 9 hypotheses were adopted.

Since TI showed significant impact on PEOU and PU with 0.325 (p<.001) and 0.247 (p<.001) of path coefficients, H1 and H2 were accepted. Consumers retaining technology innovation were found to perceive the use of smart clothing easy and its usefulness as predicted in the hypotheses.

Since CI significantly affected PEOU (path coefficient=0.200, p<.001) and PU (path coefficient=0.146, p=0.002), H3 and H4 were accepted. In other words, since smart clothing will be perceived as a clothing product even if it has been combined with an innovative electronic product, consumers' clothing involvement will induce interest in the product; accordingly, consumers will perceive the use of the product to be easy including its usefulness. Therefore, clothing involvement was found to be an important antecedent variable in case of the TAM of smart clothing.

As already proven by a number of studies, H3; PEOU will have impacts on PU (path coefficient= 0.486, p<.001) and H5; PU will affect A (path coefficient=0.905, p<.001) were accepted. Most of the studies on TAM found that PEOU directly affected PU and indirectly affected A through PU (Davis et al., 1989; Igbaria et al., 1997; Mathieson, 1991). PEOU was identified as a significant variable having an direct effect on PU. PU was a critical variable in inducing the favorable attitudes of consumers regarding smart clothing.

H4; PEOU will have effects on A was rejected. Davis et al. (1989) reported that PEOU had direct impacts on A in some cases but indirectly affected A through PU in others. They added that both variables had significant effects, but that PEOU had relatively less impact than PU. Moreover, existing studies on TAM showed PU to have direct impacts on A and AI consistently, but the effects of PEOU on A and AI were inconsistent. In adopting smart clothing, consumers can be said to form attitudes after perceiving

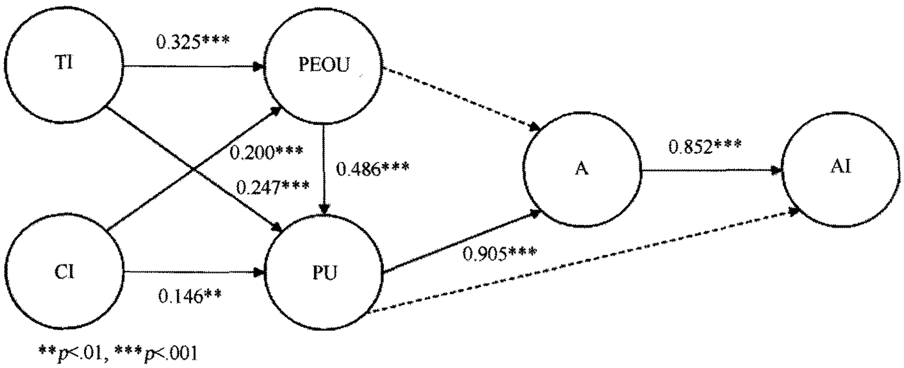

Fig. 3. The extended TAM of the perceived group.

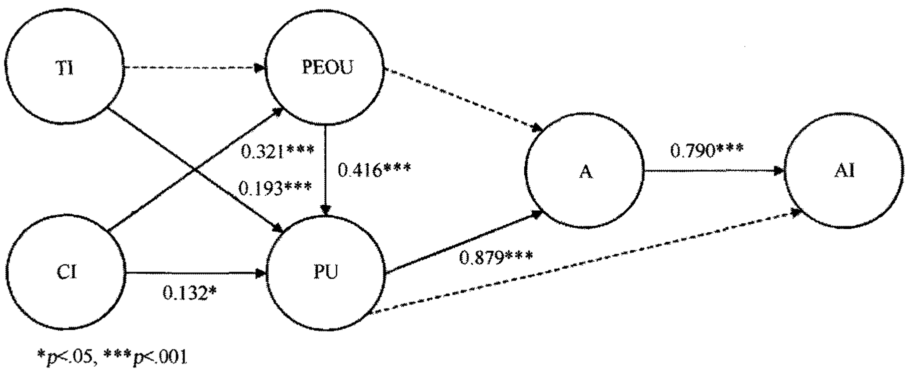

Fig. 4. The extended TAM of the non-perceived group.

Table 4. Results of hypothesis verification of the research model

Hypotheses	Parameters			Group	Estimated Values	Standardized Estimates	Standard Errors (SE)	Critical Ratio (CR)	Significance (P)	Remarks
H1	TI	→	PEOU	Perceived	0.273	0.325	0.049	5.598	***	S
				Non-Perceived	0.092	0.103	0.056	1.662	0.096	N.S.
H2	TI	→	PU	Perceived	0.212	0.247	0.042	5.090	***	S
				Non-Perceived	0.175	0.193	0.051	3.445	***	S
H3	CI	→	PEOU	Perceived	0.175	0.200	0.050	3.492	***	S
				Non-Perceived	0.267	0.321	0.053	5.067	***	S
H4	CI	→	PU	Perceived	0.131	0.146	0.042	3.128	**	S
				Non-Perceived	0.111	0.132	0.049	2.275	*	S
H5	PEOU	→	PU	Perceived	0.495	0.486	0.045	10.930	***	S
				Non-Perceived	0.421	0.416	0.056	7.543	***	S
H6	PEOU	→	A	Perceived	0.013	0.012	0.038	0.341	0.733	N.S.
				Non-Perceived	0.001	0.001	0.041	0.025	0.980	N.S.
H7	PU	→	A	Perceived	0.922	0.905	0.050	18.371	***	S
				Non-Perceived	0.927	0.879	0.053	17.436	***	S
H8	PU	→	AI	Perceived	0.181	0.170	0.098	1.850	0.064	N.S.
				Non-Perceived	0.129	0.108	0.100	1.290	0.197	N.S.
H9	A	→	AI	Perceived	0.791	0.752	0.102	7.770	***	S
				Non-Perceived	0.890	0.790	0.099	8.973	***	S

$^{***}p<.001$

its usefulness rather than directly developing favorable attitudes just because the product is easy to use.

Since PU did not show significant impacts on AI, H8 was rejected. Majority of the studies on electronic technology have proven the impacts of PU on AI. when it comes to the adoption of smart clothing, however, consumers will likely develop the intention to adopt the clothing after adopting favorable attitudes rather than having direct adoption intention after perceiving the usefulness of the product.

H9; A will affect the AI was accepted (path coefficient= 0.752, $p<.001$). In terms of other information technology, some studies supported the mediating effects of attitudes (Adams et al., 1992; Jackson et al., 1997), whereas others reported low impacts (Davis et al., 1989). This study proved that the mediating role of attitudes was highly critical in accepting smart clothing.

2) The Non-Perceived Group for Smart Clothing

6 out of 9 hypotheses were accepted in case of the extened TAM of the non-perceived group for smart clothing. Unlike the perceived group, TI did not show significant effects on PEOU, and H1 was rejected. TI had significant impacts on PU (path coefficient=0.193, $p<.001$), with CI significantly influencing PEOU (path coefficient=0.321, $p<.001$) and PU (path coefficient= 0.132, $p<.001$). Therefore, H2, H3, and H4 were accepted. TI can be said not to have impacts on PEOU since the non-perceived group was not aware of the fact that smart clothing was an innovative product combined with electronic technology.

On the contrary, the group's path coefficient that CI had impacts on PEOU was found to be higher than its counterpart since the group most likely perceived the clothing simply as clothes.

Like the perceived group, the impacts of PEOU on PU (path coefficient=0.416, $p<.001$) and effects of PU on A (path coefficient=0.879, $p<.001$) were significant so H5 and H7 were accepted. H6; PEOU will affect A was rejected. The group revealed a lower path coefficient of PU to A than its counterpart. Thus, the impacts on the group's attitudes could be said to be relatively low since it did not know the usefulness of the product compared to its counterpart.

H8 was rejected due to the insignificant impacts of PU on AI. Similar to the perceived group, the impacts of A on AI (path coefficient=0.790, p<.001) were significant. Therefore, H9 was accepted.

VI. Conclusions

As the next-generation clothing wherein innovative technology is combined to satisfy the new demands of customers and is suitable for the digital era, smart clothing is expected to play a key role in the industry. In fact, some products have already been launched in the market. Accordingly, a model for analyzing the adoption of smart clothing -- an innovative product -- was built in this study to establish the strategic basis for the commercialization of the clothing. The TAM, which has been proven to be the most influential model so far since its presentation by Davis (1989) among studies on the acceptance of information technology, was extended by adding consumers' technological innovation and clothing involvement, which were expected to affect TAM due to the characteristics of smart clothing. The fitness of the model was tested, and the differences in the perceived group and non-perceived group for smart clothing with regard to path hypotheses were analyzed.

As a result, the fitness of the extended TAM to explain the process of adopting smart clothing was proven; according to the comparison of path hypotheses of the perceived group and non-perceived group for smart clothing, their paths were not identical. The detailed analysis results and implications are as follows:

First, TI and CI are confirmed as antecedent variables with influence on TAM. In the perceived group for smart clothing, both showed impacts on the PEOU and PU. In the non-perceived group for smart clothing, TI did not have impacts on PEOU; the impacts of CI on PEOU were comparatively higher than its counterpart. This proves that consumers who are not aware of the fact that electronic technology has been combined with smart clothing will simply perceive the clothing as a clothing product. Accordingly, this suggests that it need to produce smart clothing with various designs considering brands or fashion aspects to draw the attention of consumers with high clothing involvement.

Second, PEOU had impacts on PU and indirectly influenced A through the PU in both groups. This finding supports that PU is a more crucial variable than PEOU (Kang & Jin, 2007: Lee, 2008). This also implies that favorable attitudes toward the product -- unlike the adoption of other innovative technology -- cannot be developed only from the ease of using the product in adopting smart clothing. So marketers need to educate consumers and let them know the useful function of smart clothing in order to increase it's value.

Third, PU did not show direct effects on AI but indirectly affected AI through A. Attitude were found to be an important parameter in adopting smart clothing while Davis et al. (1989) suggested that mediating role of attitude was weak. This results support the study of Kang and Jin (2007) that the attitude towards smart clothing has a direct effect on the buying intention of smart clothing. Also This implies that consumers first perceive the usefulness of smart clothing, and then they take favorable attitudes toward the clothing and finally have the intention to adopt smart clothing. In particular, the impacts of A on AI in the perceived group were relatively higher than its counterpart; they will most likely have the intention to adopt smart clothing if they have knowledge of smart clothing. Therefore, strategies for publishing and informing consumers of the functions of smart clothing and usefulness in life are necessary; understanding what useful values they expect from the clothing is also crucial.

This study has a few limitations. First, consumers' individualistic characteristics or demographic variables were not considered. According to the two variables, markets will be classified differently, and there will be differences in antecedent variables that can have impacts depending on the development of smart clothing and its commercialization stage. Second, people who are in their 30s accounted for the biggest part in terms of sample distribution; from the aspect of income, their monthly incomes were generally less than 4 million won. Third, this study analyzed MP3-

playing clothes, sensing sportswear, and photonic clothes altogether, but there may be differences in age groups having interest in and consuming smart clothing depending on the product type. For instance, people who are in their 20s-30s will mainly purchase MP3-playing clothes; sensing sportswear will probably be consumed by age groups with higher interests in health. Further research that analyzes the differences occurring in consumers' age groups depending on the product type of smart clothing would be suggested.

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