Acceptance of Smart Clothing Based on Outdoor Consumption Behavior

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Abstract: Recently, following the commercialization and market entry of smart clothes with diverse functions, smart clothes have been changing from technology-centered products to user-centered products. However, the analysis of consumer demand centered on actual commercialized products is lacking. Therefore, this study classified commercialized smart clothes by function and analyzed the demand and requirements of smart clothes according to sports/outdoor clothes consumption behaviors. As a result, consumers were classified according to their sports/outdoor clothes consumption behaviors into an outdoor leading group with high consumption propensity, an outdoor pursuit group with medium consumption propensity, and an outdoor following group with low consumption propensity. Among the commercialized smart clothes, those with a heartbeat measuring function, those with a heating function, and those with a light-emitting function were presented and demand analysis was conducted. According to the results, the outdoor leading group and the outdoor pursuit group had higher levels of awareness, preference, and purchase intentions than the outdoor following group. In addition, the outdoor leading group showed the highest level of purchase price acceptance while the outdoor following group showed the lowest level of purchase price acceptance. However, this study has a limitation that the acceptance for smart clothes were analyzed with consumers who had experience in sports outdoor clothes consumption. Therefore, in future, studies will be conducted with a wide range of consumers.

Key words: sports/outdoor clothes, consumption behavior, smart clothes, demand, price acceptance

1. Introduction

Following the recent miniaturization and weight lightening of hardware and the expansion of Internet of Things(IoT) services, the wearable device market has been growing rapidly(Lee & Pan, 2017). This trend is affecting the smart clothes market, which is one of the fields of wearable devices, leading to market expansion through smart clothes products with diverse functions such as bio signal monitoring clothes, heating clothes, and leisure safety clothes (Kang & Lee, 2017; Lee et al., 2017). As such, smart clothes technology development is shifting from the existing product developer-oriented technology development to user-oriented commercialization R&D(Jung et al., 2017; Kim et al., 2016; Lee, 2014).

Studies on consumer demand for smart clothes have been continuously conducted since the mid-2000s when studies on smart clothes began in earnest under diverse themes. Following the commercialization of smart clothes, studies that analyzed and presented consumer demand have been continuously conducted such as the analysis of the awareness and acceptability of smart clothes prod-

ucts(Choi & Lee, 2006; Hwang & Lee, 2006; Jung et al., 2017), lifestyle and trend based demand analysis for the planning and development of smart clothes(Chen et al., 2017; Cho et al., 2010; Cho et al., 2014; Ju & Hu, 2017; Jung et al., 2017), usability evaluation, analysis of smart clothes consumer attitudes and acceptance according to consumer innovativeness(Chae et al., 2009; Kang & Jin, 2007; Noh & Park, 2011; Park & Noh, 2012; Sung & Sung, 2015), and analysis of elements for application of user centered devices and applications(Choi & Lee, 2009; Lee & Pan, 2017).

However, existing studies have limitations in the analysis of demands by age group because they were conducted with mainly persons in their 20-30s who are expected to have high levels of accessibility to and understanding of smart devices, and studies for empirical demand analysis based on commercialized smart clothes are lacking.

Therefore, in this study, the age range of analysis was expanded to twenties-sixties to analyze the demand and price acceptance for smart clothing according to the smart clothing consumption behaviors by age group with a view to presenting basic data for planning of smart clothing through segmentalized demand forecasting of smart clothing.

2. Study method

2.1. Classification of commercialized smart clothes

In this study, to analyze demands for commercialized smart

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clothes by function, smart clothes were clustered into groups in similar price ranges centering on their functions. The outcomes were used in consumer demand analysis as data presented to analyze consumer demands by function and by price range. The applied smart clothing was determined by searching commercialized smart clothing based on the Internet and research papers. As a result of the search, bio signal measuring clothes based on heart rate and electrocardiogram measurement functions, leisure clothes for night safety using optical fibers and LEDs, heating clothes applied with a heating function to adjust temperature, NFC, gesture communication clothes were found.

A total of four types of heating functional clothes were found, which are Colmar Co.'s Graphene Plus (G+), RAAVEAN's Heated Down Jacket, GERBING's Heating Jacket, and AiQ's Heating jacket. Nine types of bio-signal measuring clothes were found, which are OMsignal's Ombra, Maxim's Fit Shirt, Ralph Lauren's Polotech Shirt, Hexoskin's Biometric shirts, and Gymi's smart shirts & smart pants, Sensecore's smart sports clothing that have heart measuring functions, and Myontec's Mbody, Athos' Athos gear, Far East New Century Corp's DynaFeed, NTT Docomo's Hitoe, and AiQ's Lighting jacket based on EMG measurements. Six types of light-emitting clothes were found, which are Marmot's Phenomenon EL, Visijax's SMART LED jacket, Lumo's harrington jacket, O'Neill's Nav Jacket, Nite Ize's LED Sport Vest, Utope's Sporty Supaheroe Jacket, METIER's Metier Beacon Men's Jacket, PROVIZ's Nightrider LED Women's Cycling Jacket. Other clothing products found were three types, which are Samsung NFC suit, Google x Levi's Project Jacquard, and LIVE DEMO's midi controller jacket. For consumer demand analysis, products that were currently on the market among the above listed products were grouped into products with similar functions and prices, and the functions and prices of the products were presented.

2.1.1. Smart clothes with heartbeat and momentum measuring functions

The bio-signal measuring clothes presented were composed of MyZone series(MyZone, USA) with heartbeat and momentum measuring functions as their main functions and OMBra(Omsignl, Canada) with heartbeat, breathing, and momentum measuring functions using film type piezoelectric electrodes from DuPont (Table 1).

2.1.2. Smart clothes with a heating function

Heated clothes with a thermal function presented were composed of a heated down jacket(Ravean, Canada) applied with heating pads placed at six points and a curved battery to increase fitting sensation, and a heated jacket(GERBING, USA) embedded with seven heating pads in the back and chest areas and a 12V battery for power supply.

2.1.3. Smart clothes with a light-emitting function

Leisure clothes with a night safety light-emitting function presented were composed of a Nightrider LED Women's Cycling Jacket(PROVIZ, England) with LED bands attached to the sleeve regions and the bottom region to secure the visibility of the rider and a Women's Beacon Jacket(Metier, England) with LED strips attached to the front shoulder region and the back bottom region to secure night visibility.

2.2. Composition of the questionnaire

The questionnaire was composed of a total of 30 questions. To analyze demands for smart clothing by function according to sports

Table 1. Smart clothes with a heartbeat measuring function

Product	Product name (manufacturer/country)	Price
	MyZone series (MyZone/USA) Sports Bra/T-shirt can be worn in diverse forms. Heartbeats can be inferred by measuring blood flow changes through wearable optical blood flow measuring device (LED and photodetector) *https://buy.myzone.org/product/?code=SPORTS-BRA*	$199
	OMBra (Omsignal/Canada) The product line is being expanded according to lifestyles, and heartbeats can be measured using DuPont's film type electrodes. It is thin, comfortable to wear and washable. *https://omsignal.com/collection* *https://www.dezeen.com/*	$169

Table 2. Smart clothes with a heating function

Product	Product name (manufacturer/country)	Price
	Heated Down Jacket(RAVEAN/Canada) Heating pads placed at six points; a curved battery is used to increase fitting sensation; the battery can be used for 15 hours at 600mAh; a controller was inserted into the inside of the jacket (below the collar). Heating gloves and a hood can be additionally purchased. Two batteries can be held. *https://ravean.com/collections/frontpage/products/mens-down-x-heated-jacket-battery-bundle*	$229.99
	Heating Jacket (GERBING/USA) Embedded with seven heating pads in the front/back body, the left/right arm and collar regions. This jacket has a function to supply heat to the fitting regions in several seconds and the power is supplied through a 12V battery. *https://www.gerbing.com/mens-jacket-liner*	$249.99

Table 3. Smart clothes with a light-emitting function

Product	Product name (manufacturer/country)	Price
	Nightrider LED Women's Cycling Jacket (PROVIZ/UK) LEDs are built into the rear arm and back to increase visibility during cycle riding. The function is realized by supplying power through a rechargeable battery. *https://www.provizsports.com/en-gb/*	$239.49
	Metier Beacon Men's Jacket(METIER/UK) LEDs are built into the shoulder and waist to ensure visibility in the dark. The function is realized by supplying power through a rechargeable battery. *https://www.condorcycles.com/products/metier-beacon-men-s-rain-cape*	$242.20

Table 4. Composition of the questionnaire

Category	Items	Number of questions
Sports/ outdoor clothes consumption behavior	Sports/ outdoor clothes consumption	4 questions
General smart clothes demand evaluation	Smart clothes awareness and value evaluation	4 questions
	Smart clothes demand	3 questions
Evaluation of demands for smart clothes by function	Demand for clothes with heartbeat measuring function	5 questions
	Demand for clothes with heating function	5 questions
	Demand for clothes with light-emitting function	5 questions
Demographic questions	Demographic characteristics	4 questions
Total		30 questions

and outdoor clothing consumption behaviors, questions were extracted from questions used in previous studies(Cho et al., 2010; Choi & Lee, 2006; Kang, 2015; Lee, 2015) and the questions were modified to fit the content of this study in order to compose questions in this study. Four questions related to sports and outdoor clothing consumption were composed, and seven questions related to the awareness and value of and demand for smart clothing were composed for the evaluation of demand for general smart clothing.

Fifteen questions regarding the awareness of, purchase intention and acceptable prices for the smart clothes with heart rate measurement, heating, or light-emitting functions classified earlier were composed for the evaluation of demands for smart clothes by function, and four demographic questions were composed.

Twelve questions related to demand for smart clothing were applied to five-point Likert scale and seventeen questions including demographic characteristics were applied to nominal scale. One

question on the function of pursuing smart clothing was applied to a subjective way.

In order to evaluate demands for smart clothes by function, a stimulant consisting of photos of commercialized smart clothes and descriptions of major functions and prices was presented so that the respondents could respond to the questionnaire after understanding the grouped smart clothes.

2.3. Survey subjects and data analysis

In order to analyze demands for smart clothes by function according to sports/outdoor clothes consumption behaviors, a total of 1,000 questionnaire sheets were distributed from November 1 to December 20, 2017, and the sports/outdoor clothes consumption behaviors of 646 subjects who had purchased sports/outdoor clothes within one year were analyzed thereby analyzing demands for smart clothes according to functions by group. To that end, K-means cluster analysis was conducted for group clustering through the application of the statistical program SPSS 20.0, and crossover analysis and ANOVAs were carried out for demand analysis. Subjective answers were analyzed after grouping through lexical-semantic organization.

3. Result and discussion

3.1. Group classification according to sports/outdoor clothes consumption behaviors

3.1.1. Cluster classification according to consumption behaviors

Reference values of the results of questions regarding whether sports/outdoor clothes were purchased, the number of suits purchased, clothes purchase frequency, and clothes purchase amount were obtained through data standardization processes and K-means cluster analysis was conducted. As a result, the respondents were classified into three groups; group 1 with 245 respondents, group 2 with 262 respondents, group 3 with 139 respondents. The group classification was shown to be statistically significant.

3.1.2. Analysis of demographic characteristics by cluster according to outdoor clothes consumption behaviors

Among the demographic characteristics of group 1, as for the sex ratio of males and females, the numbers of males and females were shown to be similar, as for the ages, the number of respondents in their 20~30s was shown to be larger compared to other age groups, and as for the occupations, the distributions of office workers and university students were shown to be higher. As for the characteristics of outdoor behaviors, the number of outdoor clothes in possession was shown to be 3~5 clothes, the purchase frequency was shown to be one time per year or lower, and the purchase amount per time was shown to be about 200,000~less than 300,000 won. Therefore, group 1 was named 'outdoor following group'.

Among the demographic characteristics of group 2, as for the sex ratio of males and females, the number of males was shown to be larger than that of females, as for the ages, the number of respondents in their 30~40s was shown to be larger compared to other age groups, and as for the occupations, the ratios of business managers and technical/production workers were shown to be higher compared to other groups. The number of outdoor clothes in possession was shown to be 6?9 clothes, the purchase frequency was shown to be about one time per six months, and the purchase amount per time was shown to be about 300,000~less than 400,000 won. Therefore, group 2 was named 'outdoor pursuit group'.

Among the demographic characteristics of group 3, as for the sex ratio of males and females, the numbers of males and females were shown to be similar, as for the ages, the number of respondents in their 40s or older was shown to be larger compared to other age groups. As for the characteristics of outdoor behaviors, the number of outdoor clothes in possession was shown to be at least 10 clothes, the purchase frequency was shown to be at least one time per three months, and the purchase amount per time was shown to be about 1 million~less than 2 million won. Therefore, group 3 was named 'outdoor leading group'.

3.2. Evaluation of demand for general smart clothes

3.2.1. Evaluation of awareness and value of smart clothes

1) Awareness of smart clothes

Whether smart clothes are recognized by group was analyzed and the results indicated that the level of awareness was higher in the outdoor pursuit and leading groups compared to the outdoor following group. The levels of awareness were shown to be relatively higher among male and respondents with high outdoor purchase frequencies and purchase amounts and were shown to be low

Table 5. Cluster classification according to outdoor clothes consumption behaviors

Item	Group classification			F	p
	1	2	3		
Number of outdoor clothes	−.80970	−.23625	1.01596	317.309***	.000
Purchase frequency of outdoor clothes	.68863	.84251	1.75618	435.935***	.000
Purchase amount of outdoor clothes	−.50133	−.36311	1.56806	679.764***	.000

***$p<.001$

Table 6. Crossover analysis of outdoor clothes consumption behaviors by group

		1	2	3	χ^2
		N(%)	N(%)	N(%)	
Number of suits of outdoor clothes	At least 10	0(0.0)	56(21.4)	79(58.8)	392.874*** (P = .000)
	6~9	9(3.7)	111(42.4)	37(26.6)	
	3~5	140(57.1)	91(34.7)	20(14.4)	
	1~2	96(39.2)	4(1.5)	3(2.2)	
	Total	245(100.0)	262(100.0)	139(100.0)	
Purchase frequency of outdoor clothes	At least once per three months	0(0.0)	0(0.0)	75(54.0)	465.994*** (P = .000)
	About once per six months	19(7.8)	159(60.7)	55(39.6)	
	About once per year	143(58.4)	63(24.0)	7(5.0)	
	About once per 2~3 years	76(31.0)	40(15.3)	2(1.4)	
	Less frequently	7(2.9)	0(0.0)	0(0.0)	
	Total	245(100.0)	262(100.0)	139(100.0)	
Purchase amount of outdoor clothes	Less than 100,000 won	15(6.1)	5(1.9)	0(0.0)	572.242*** (P = .000)
	100,000~less than 200,000 won	57(23.3)	37(14.1)	0(0.0)	
	200,000~less than 300,000 won	63(25.7)	63(24.0)	0(0.0)	
	300,000~less than 400,000 won	48(19.6)	73(27.9)	0(0.0)	
	400,000~less than 500,000 won	30(12.2)	38(14.5)	0(0.0)	
	500,000~less than 600,000 won	22(9.0)	43(16.4)	8(5.8)	
	600,000~less than 700,000 won	6(2.4)	3(1.1)	21(15.1)	
	700,000~less than 800,000 won	3(1.2)	0(0.0)	22(15.8)	
	800,000~less than 900,00 won	0(0.0)	0(0.0)	26(18.7)	
	900,000~less than 1 million won	0(0.0)	0(0.0)	13(9.4)	
	1 million~less than 2 million won	1(.04)	0(0.0)	38(27.3)	
	Over 2 million won	0(0.0)	0(0.0)	11(7.9)	
	Total	245(100.0)	262(100.0)	139(100.0)	

***$p < .001$

among females, respondents in their 20s, and those who did not purchase any outdoor clothes within the last one year.

2) Perception of smart clothes

The images of smart clothes perceived by consumers were not different among the groups, and it shown that smart clothes were perceived as 'having been grafted with high technologies, equipped with digital sensors, IT convergence, and interlocked with smartphone application, etc.'. The tendency to perceive the images of smart clothes as clothes embedded with the functionality connected with IT technologies such as 'grafting of high technologies/digital sensors/IT technologies was shown to be prominent.

3) Necessity of smart clothes

With regard to the necessity of smart clothes, the outdoor leading group and the pursuit group were shown to recognize the necessity of smart as higher compared to the outdoor following group. That is, the necessity of smart clothes was recognized as higher among

respondents in their 40s or over 50s compared to those in their 20s or 30s. This result was found to be similar to that of previous studies(Hwang & Lee, 2006; Kang, 2009) in which those who were not familiar to smart technologies evaluated the innovativeness of smart clothes more highly.

4) Value of smart clothes

Analyses were conducted to evaluate the value of smart clothes and according to the results, the outdoor leading group and the outdoor pursuit group showed higher tendencies to perceive that IT functions enhanced the value of clothes compared to the outdoor following group.

Among the reasons why the respondents perceived that IT functions would enhance the value of clothes, 'make life more convenient' was the most frequent followed by 'enhance functionality' and 'contribute to health management' in order of precedence and among the reasons why the respondents perceived that IT functions had nothing to do with the value of clothes, 'prices are high' was

Table 7. Demographic characteristics of survey subjects

		1	2	3	χ^2
		N(%)	N(%)	N(%)	
Sex	Male	118(48.2)	162(61.8)	71(51.1)	10.290** (*P* = .006)
	Female	127(51.8)	100(38.2)	68(48.9)	
	Total	245(100.0)	262(100.0)	139(100.0)	
Age	20s	75(30.6)	42(16.0)	18(12.9)	14.973* (*P* = .020)
	30s	92(37.6)	71(27.1)	29(20.9)	
	40s	42(17.1)	102(38.9)	45(32.4)	
	50s or older	36(14.7)	47(17.9)	47(33.8)	
	Total	245(100.0)	262(100.0)	139(100.0)	
Occupation	Office worker	84(34.3)	78(29.8)	36(25.9)	34.247* (*P* = .012)
	Self-employed	3(1.2)	28(10.7)	20(14.4)	
	Professional	28(11.4)	28(10.7)	12(8.6)	
	Salesperson	12(4.9)	13(5.0)	6(4.3)	
	Public official	3(1.2)	9(3.4)	4(2.9)	
	Business manager	16(6.5)	30(11.5)	15(10.8)	
	Technical/production worker	13(5.3)	19(7.3)	8(5.8)	
	Housewife	41(16.7)	21(8.0)	23(16..5)	
	University student	23(9.4)	15(5.7)	8(5.8)	
	Other and unemployed	22(9.0)	21(8.0)	7(5.0)	
	Total	245(100.0)	262(100.0)	139(100.0)	
Region	Seoul	91(37.1)	103(39.3)	46(33.1)	9.847 (*P* = .773)
	Gyeonggi / Incheon	66(26.9)	68(26.0)	37(26.6)	
	Chungcheong	15(6.1)	17(6.5)	14(10.1)	
	Gyeongbuk	17(6.9)	15(5.7)	16(11.5)	
	Gyeongnam	40(16.3)	43(16.4)	18(12.9)	
	Gangwon	12(4.9)	13(5.0)	7(5.0)	
	Jeonbuk	3(1.2)	3(1.1)	1(0.7)	
	Jeonnam	1(0.4)	0(0.0)	0(0.0)	
	Total	245(100.0)	262(100.0)	139(100.0)	

*p < .05, **p < .01

Table 8. Awareness of smart clothes

Item	Outdoor following group	Outdoor pursuit group	Outdoor leading group	F	p	Post-hoc
	Mean ± SD	Mean ± SD	Mean ± SD			
Awareness of smart clothes	2.25 ± .68	2.45 ± .69	2.54 ± .72	7.738*	.030	a < b, c

*p < .05

the most frequent followed by 'the functions are not necessary' and 'the necessity may vary among consumers' in order of precedence.

In addition, in the case of respondents in over 50s, those with higher outdoor purchase frequencies and purchase amounts were shown to be more likely to perceive that IT functions would enhance the value of clothes.

3.2.2. Evaluation of demand for smart clothes
1) Types of clothes for applying smart functions

Crossover analyses of the best suited clothes for smart clothes were conducted and the results showed no differences among the groups. Sports/outdoor clothes were found to suit best for smart clothes followed by casual clothes, suits, and golf clothes in order of precedence.

2) Purchase intentions according to smart functions

Purchase intentions according to smart functions were analyzed, and the results indicated that when desired smart functions were added, purchase intentions increased more in the outdoor leading group and the outdoor pursuit group compared to the outdoor following group.

Table 9. Perception of smart clothes' functions

		Outdoor following group	Outdoor pursuit group	Outdoor leading group	Total	χ^2
		N(%)	N(%)	N(%)	N(%)	
Technologies grafting image related	Grafted with high technologies	35(14.3)	39(14.9)	23(16.5)	97(15.0)	
	Equipped with digital sensor	32(13.1)	33(12.6)	20(14.4)	85(13.2)	
	Grafted with IT technology	29(11.8)	34(13.0)	16(11.5)	79(12.2)	
	Interlocked with smart phone application	27(11.0)	32(12.2)	16(11.5)	75(11.6)	
	Grafted with smart devices	24(9.8)	24(9.2)	10(7.2)	58(9.0)	6.247
	Interlocked with electronic equipment	21(8.6)	20(7.6)	9(6.5)	50(7.7)	(P = .812)
	Wearable	18(7.3)	22(8.4)	16(11.5)	56(8.7)	
	For convenience of life	16(6.5)	18(6.9)	13(9.4)	47(7.3)	
	Diverse functions	14(5.7)	11(4.2)	2(1.4)	27(4.2)	
	Other	29(11.8)	29(11.1)	14(10.1)	72(11.1)	
	Total	245(82.4)	262(84.7)	139(88.5)	646(100.0)	

Table 10. Necessity of smart clothes

Item	Outdoor following group	Outdoor pursuit group	Outdoor leading group	F	p	Post-hoc
	Mean ± SD	Mean ± SD	Mean ± SD			
Necessity of smart clothes	3.37 ± .86	3.55 ± .86	3.67 ± .93	8.764**	.004	a < b, c

**$p < .01$

Table 11. Value of smart clothes

Item	Outdoor following group	Outdoor pursuit group	Outdoor leading group	F	p	Post-hoc
	Mean ± SD	Mean ± SD	Mean ± SD			
Value of smart clothes	3.25 ± .61	3.77 ± .60	3.98 ± .42	28.337*	.018	a < b, c

*$p < .05$

Table 12. Clothes applied with smart functions

		Outdoor following group	Outdoor pursuit group	Outdoor leading group	χ^2
		N(%)	N(%)	N(%)	
Clothes applied with smart functions	Casual clothes	20(8.2)	19(7.3)	7(5.0)	
	Suit	11(4.5)	14(5.3)	12(8.6)	
	Golf clothes	16(6.5)	17(6.5)	4(2.9)	10.556
	Sports/outdoor clothes	198(80.8)	211(80.5)	114(82.0)	(P = .658)
	Other	0(0.0)	1(0.4)	2(1.4)	
	Total	245(100.0)	262(100.0)	139(100.0)	

3) Preferences for the forms of sales of smart clothes and smart devices

The forms of sales of smart clothes and smart devices were analyzed and according to the results, the preferences for 'selling smart clothes and smart devices separately' and 'selling smart clothes embedded with smart devices' were similar and there was no difference among the groups.

3.3. Evaluation of demands for smart clothes by function
3.3.1. Evaluation of demands for heartbeat measuring clothes
1) Awareness of heartbeat measuring clothes
Whether the respondents were aware of heartbeat measuring

clothes was analyzed and according to the results, 18.2%(n = 118) of all respondents were aware of heartbeat measuring clothes and there was no significant difference among the groups.

2) Preference for heartbeat measuring clothes

Heartbeat measuring clothes were presented and the preference was evaluated and according to the results, all groups showed positive evaluations of at least 'moderate'. The outdoor pursuit group and the outdoor leading group were shown to have higher preference for heartbeat measuring clothes compared to the outdoor following group.

Table 13. Purchase intentions according to smart functions

Item	Outdoor following group	Outdoor pursuit group	Outdoor leading group	F	p	Post-hoc
	Mean ± SD	Mean ± SD	Mean ± SD			
Purchase intentions when desired functions were added	3.26 ± .63	3.60 ± .64	3.67 ± .64	20.993**	.002	a < b, c

**p<.01

Table 14. Preferences for the forms of sales of smart clothes and smart devices

		Outdoor following group	Outdoor pursuit group	Outdoor leading group	χ^2
		N(%)	N(%)	N(%)	
Preference for Smart clothes	Prefer buying smart clothes and smart devices separately	112(45.7)	114(43.5)	71(51.1)	3.430 (P = .489)
	Prefer embedded smart devices	114(46.5)	122(46.6)	60(43.2)	
	Do not care	19(7.8)	26(9.9)	8(5.8)	
	Total	245(100.0)	262(100.0)	139(100.0)	

Table 15. Evaluation of the awareness of heartbeat measuring clothes

		Outdoor following group	Outdoor pursuit group	Outdoor leading group	χ^2
		N(%)	N(%)	N(%)	
Awareness of heartbeat measuring clothes	Originally knew	36(14.7)	58(22.1)	24(17.3)	4.817 (P = .090)
	Became to know now	209(85.3)	204(77.9)	115(82.7)	
	Total	245(100.0)	262(100.0)	139(100.0)	

Table 16. Evaluation of preference for heartbeat measuring clothes

Item	Outdoor following group	Outdoor pursuit group	Outdoor leading group	F	p	Post-hoc
	Mean ± SD	Mean ± SD	Mean ± SD			
Evaluation of preference for heartbeat measuring clothes	3.66 ± .80	3.90 ± .79	3.89 ± .89	8.224**	.002	a < b, c

**p < .01

Table 17. Purchase intention of heartbeat measuring clothes

Item	Outdoor following group	Outdoor pursuit group	Outdoor leading group	F	p	Post-hoc
	Mean ± SD	Mean ± SD	Mean ± SD			
Purchase intention of heartbeat measuring clothes	2.91 ± .68	3.22 ± .63	3.34 ± .71	19.599**	.005	a < b, c
Purchase intention at the current price purchase	2.67 ± 1.09	2.97 ± 1.11	3.28 ± 1.24	33.183***	.000	a < b < c

**p < .01, ***p < .001

3) Purchase intentions and price appropriateness of heartbeat measuring clothes

The outdoor pursuit group and the outdoor leading group were shown to have stronger purchase intentions compared to the outdoor following group through analysis. After the prices of heartbeat measuring clothes were presented, the outdoor leading group was shown to have the strongest purchase intention followed by the outdoor pursuit group and the outdoor following group, in order of precedence in an analysis. All the three groups were shown to have weaker purchase intentions after he prices of heartbeat measuring clothes were presented compared to before the prices were pre-

sented through the analysis indicating that the prices of heartbeat measuring clothes were set to be higher compared to consumer demands.

In the evaluation of appropriate prices of heartbeat measuring smart clothes, no differences appeared among the groups and it was shown that prices in a range of 50,000~less than 100,000 won were thought to be the most appropriate.

3.3.2. Evaluation of demand for heated clothes

1) Awareness of heated clothes

As for the awareness of smart clothes with a heating function, it

Table 18. Price appropriateness of heartbeat measuring clothes

Price range		Outdoor following group	Outdoor pursuit group	Outdoor leading group	χ^2
		N(%)	N(%)	N(%)	
Price appropriateness of heartbeat measuring clothes	Less than 50,000won	53(21.6)	63(24.0)	30(21.6)	
	50,000 ~ less than 100,000 won	97(39.6)	88(33.6)	58(41.7)	
	100,000 ~ less than 150,000 won	38(15.5)	45(17.2)	16(11.5)	
	150,000 ~ less than 200,000 won	24(9.8)	39(14.9)	22(15.8)	13.190
	200,000 ~ less than 250,000 won	5(2.0)	2(0.8)	0(0.0)	(P=.345)
	250,000 ~ less than 300,000 won	15(6.1)	11(4.2)	7(5.0)	
	over 300,000 won	13(5.3)	14(5.3)	6(4.3)	
	Total	245(100.0)	262(100.0)	139(100.0)	

Table 19. Awareness of heated clothes

		Outdoor following group	Outdoor pursuit group	Outdoor leading group	χ^2
		N(%)	N(%)	N(%)	
Awareness of heated clothes	Originally knew	74(30.2)	94(35.9)	68(48.9)	13.481[**]
	Became to know now	171(69.8)	168(64.1)	71(51.1)	(P = .001)
	Total	245(100.0)	262(100.0)	139(100.0)	

[**]$p < .01$

Table 20. Demand for heated clothes

Item	Outdoor following group	Outdoor pursuit group	Outdoor leading group	F	p	Post-hoc
	Mean ± SD	Mean ± SD	Mean ± SD			
Demand evaluation of heated clothes	3.98 ± .78	4.14 ± .70	4.14 ± .80	3.941[*]	.032	a < b, c

[*]$p < .05$

Table 21. Purchase intentions and price appropriateness of heated clothes

Item	Outdoor following group	Outdoor pursuit group	Outdoor leading group	F	p	Post-hoc
	Mean ± SD	Mean ± SD	Mean ± SD			
Purchase intentions when the heating function has been added	3.44 ± .69	3.69 ± .58	3.84 ± .62	15.771[**]	.008	a < b, c
Purchase intentions at the current price	3.54 ± 1.08	3.72 ± 1.01	3.99 ± 1.06	37.815[***]	.000	a < b, c

[**]$p < .01$, [***]$p < .001$

was shown that 236(36.5%) out of the entire 646 respondents were aware of smart clothes with a heating function. The outdoor leading group was found to have the highest level of awareness followed by the outdoor pursuit group and the outdoor following group in order of precedence.

2) Preference for heated clothes

The outdoor pursuit group and the outdoor leading group showed higher preference for smart clothes with a heating function compared to the outdoor following group. Among the presented smart clothes with heartbeat measuring, heating, and light-emitting functions, those with a heating function showed the highest preference.

3) Purchase intentions and price appropriateness of heated clothes

As for purchase intentions for smart clothes with a heating function, all respondents were shown to have at least 'moderate' purchase intentions and the outdoor pursuit group, and the outdoor leading group were shown to have stronger purchase intentions compared to the outdoor following group. When the current prices of heating clothes were presented and purchase intentions were evaluated thereafter, the outdoor pursuit group and the outdoor leading group showed stronger purchase intentions and the purchase intentions increased after the prices were presented.

As for the appropriate prices of heated clothes, responses indi-

Table 22. Analysis of appropriate prices of heated clothes

	Outdoor following group	Outdoor pursuit group	Outdoor leading group	χ^2
	N(%)	N(%)	N(%)	
	Less than 100,000won	5(2.0)	5(1.9)	3(2.2)	
	100,000 ~ less than 200,000 won	25(10.2)	17(6.5)	7(5.0)	
	200,000 ~ less than 300,000 won	26(10.6)	34(13.0)	12(8.6)	
Appropriate prices of heated clothes	300,000~ less than 400,000 won	86(35.1)	44(16.8)	18(12.9)	12.750*
	400,000 ~ less than 500,000 won	82(33.5)	72(27.5)	27(19.4)	(P = .042)
	500,000 ~ less than 1 million won	16(6.5)	72(27.5)	29(20.9)	
	Over 1 million won	5(2.0)	18(6.9)	43(30.9)	
	Total	245(100.0)	262(100.0)	139(100.0)	

*$p < .05$

Table 23. Awareness of light-emitting clothes

		Outdoor following group	Outdoor pursuit group	Outdoor leading group	χ^2
		N(%)	N(%)	N(%)	
Awareness of light-emitting clothes	Originally knew	20(8.2)	18(6.9)	20(14.4)	6.602
	Became to know now	225(91.8)	244(93.1)	119(85.6)	(P = .137)
	Total	245(100.0)	262(100.0)	139(100.0)	

Table 24. Demand for light-emitting clothes

Item	Outdoor following group	Outdoor pursuit group	Outdoor leading group	F	p	Post-hoc
	Mean±SD	Mean±SD	Mean±SD			
Preference light-emitting function	3.21±.99	3.42±1.00	3.47±1.13	8.949	.016*	a < b, c

*$p<.05$

Table 25. Purchase and price appropriateness of light-emitting clothes

Item	Outdoor following group	Outdoor pursuit group	Outdoor leading group	F	p	Post-hoc
	Mean ± SD	Mean ± SD	Mean ± SD			
Purchase intentions when the light-emitting function has been added	2.15 ± .70	2.48 ± .71	2.75 ± .76	34.317***	.000	a < b, c
Purchase intentions at current prices	2.37 ± 1.03	2.51 ± 1.01	2.82 ± 1.22	17.603**	.001	a, b < c

**$p < .01$, ***$p < .001$

cating that prices in a range of 300,000~less than 500,000 won were appropriate were the most frequent in the outdoor following group, the outdoor pursuit group indicated that prices in a range of 400,000~less than 1 million won were the most appropriate, and the outdoor leading group indicated that prices exceeding 1 million won were the most appropriate.

3.3.3. Evaluation of demand for light-emitting clothes

1) Awareness of light-emitting clothes

The awareness of smart clothes with a light-emitting function was analyzed and as a result, 9%(n = 58) of respondents answered that they were aware of such smart clothes and no difference appeared among the group. In addition, the awareness of the light-

emitting function was shown to be lower compared to the heartbeat measuring function and the heating function.

2) Preference for light-emitting clothes

The outdoor pursuit group and the outdoor leading group showed higher preference for smart clothes with a light-emitting function compared to the outdoor following group.

3) Purchase intentions and price appropriateness of light-emitting clothes

Purchase intentions for smart clothes with a light-emitting function were analyzed and according to the results, the outdoor leading group and the outdoor pursuit group had stronger purchase inten-

Table 26. Evaluation light-emitting clothes purchase intentions and price appropriateness

		Outdoor following group	Outdoor pursuit group	Outdoor leading group	χ^2
		N(%)	N(%)	N(%)	
Appropriateness of light-emitting clothes	Less than 50,000won	5(2.0)	7(2.7)	1(0.7)	6.172** (*P* = .006)
	50,000~less than 100,000 won	18(7.3)	12(4.6)	8(5.8)	
	100,000~less than 150,000 won	20(8.2)	16(6.1)	11(7.9)	
	150,000~less than 200,000 won	67(27.3)	18(6.9)	15(10.8)	
	200,000~less than 250,000 won	96(39.2)	77(29.4)	34(24.5)	
	250,000~less than 300,000 won	26(10.6)	86(32.8)	28(20.1)	
	over 300,000 won	13(5.3)	46(17.6)	42(30.2)	
	Total	245(100.0)	262(100.0)	139(100.0)	

**p < .01

tions compared to the outdoor following group.

When the prices were presented and purchase intentions were evaluated thereafter, all the three groups showed stronger purchase intentions. Among the three groups, the outdoor leading group was found to have stronger purchase intentions compared to the outdoor pursuit group and the outdoor following group.

The price appropriateness of light-emitting clothes was analyzed and according to the results, the outdoor following group preferred the price range of 200,000~less than 250,000 won the most, the outdoor pursuit group preferred the price range of 250,000~less than 300,000 won the most, and the outdoor leading group preferred the price range of over 300,000 won the most.

5. Conclusion

In this study, in order to analyze demands for smart clothes according to sports/outdoor clothes consumption behaviors, actually commercialized smart clothes by function were clustered and presented and consumer demands were analyzed.

1) The respondents were classified into three groups according to their sports/outdoor clothes consumption behaviors as follows:

An outdoor leading group of those who had bought at least 10 suits of sports/outdoor clothes, purchased sports/outdoor clothes at least once per three months, consumed 1 million~less than 2 million won per time of purchase, and were in their 40s or older in most cases, an outdoor pursuit group of those who had bought 6~9 suits of sports/outdoor clothes, purchased sports/outdoor clothes about once per six months, consumed about 300,000~less than 400,000 won per time of purchase, and were in their 30~40s in most cases, and an outdoor following group of those who had bought 3~5 suits of sports/outdoor clothes, purchased sports/outdoor clothes about once per year, consumed about 200,000~less than 300,000 won per time of purchase, and were in their 20~30s in most cases.

2) The awareness and necessity of smart clothes were shown to be higher in the outdoor leading group and the outdoor pursuit group compared to the outdoor following group in the analysis. Among the functions of smart clothes, temperature control such as body temperature control and heating was preferred the most frequently followed by health checks and exercise checks in order of precedence.

3) In the evaluation of the value of smart clothes, it was shown that when desired functions were added, the purchase intentions of the outdoor leading group and the outdoor pursuit group increased more compared to the outdoor following group.

4) The levels of awareness of heartbeat measuring smart clothes were not different among the three groups. As for preference and purchase intentions, the outdoor leading group and the outdoor pursuit group showed higher preference and purchase intentions compared to the outdoor following group. As for the acceptance of prices of heartbeat measuring smart clothes, acceptance was shown to be the highest at prices in a range of 50,000~less than 100,000 won and no difference appeared among the groups.

5) For heated smart clothes, the outdoor leading group and the outdoor pursuit group were shown to have higher awareness and preference compared to the outdoor following group. In addition, the outdoor leading group and the pursuit group showed higher levels of purchase intentions compared to then outdoor following group and showed higher purchase intentions after current prices of heated clothes were presented. This is considered attributable to the fact that the presented prices of clothes were within the range of acceptable prices presented by each group. The acceptance of heated clothes prices was shown to be the highest when the prices were at least 1 million won in the outdoor leading group, when the prices were in a range of 400,000~less than 1 million won in the outdoor pursuit group, and when the prices were in a range of 300,000~less than 500,000 won in the outdoor following group.

6) In the case of smart clothes with a light-emitting function, the outdoor leading group and the outdoor pursuit group were shown to have higher levels of awareness and preference compared to the outdoor following group. When the light-emitting function was added, the outdoor leading group and the outdoor pursuit group were shown to have stronger purchase intentions compared the outdoor following group.

As for the price acceptance for smart clothes with a light-emitting function, all the three group showed a tendency to have stronger purchase intentions after the prices were presented. Among them, the outdoor leading group was shown to have stronger purchase intentions compared to the outdoor pursuit group and the outdoor following group after the prices were presented. Therefore, in the case of light-emitting clothes, given that purchase intentions increased after the prices were presented, the current prices were considered to have been set appropriately. The most acceptable price ranges by group were shown to be 250,000~less than 300,000 won in the outdoor leading group, 200,000~less than 250,000 won in the outdoor pursuit group, and 150,000~less than 250,000 won in the outdoor following group.

According to the results of analysis in this study, as for the planning of smart clothing, proactive planning into premium products by emphasizing the functional part of smart clothing is considered necessary for the outdoor leading group of people in their 40s and older people, expansion of premium products into high price lines is considered necessary for the outdoor pursuing group of people in their 30~40s, and planning for stepwise entry into mid-to-low price lines that can be applied to single-unit items such as vests is considered necessary for the outdoor sympathy group of people in their 20~30s.

This study is meaningful in that it analyzed and presented the acceptance and acceptable price ranges for smart clothes in diverse age groups ranging from 20s to 60s based on commercialized smart clothes. However, this study has a limitation that the acceptance for smart clothes were analyzed with consumers who had experience in sports outdoor clothes consumption. Therefore, in future, studies will be conducted with a wide range of consumers.

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