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Consumer Segmentation according to the Constituent Characteristics of Knit Fabrics -Using Conjoint Analysis-

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니트 소재의 구성특성에 따른 소비자 세분화 -컨조인트 분석 이용-

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Abstract

Different people buy the same or similar products for different reasons. Benefit segmentation attempts to understand these differences by grouping together people who assign a similar level of importance to the same attributes. We focused on identifying market segments for knit fabrics by comparing the relative attribute preference for knit fabrics according to segmented clusters, and testing to establish if there were significant differences between the preferences of clusters. Three consumer segments emerged, and there were three clusters with different ideal knit profiles: a preferred wool group, a preferred acrylic group, and a preferred long stitch length group. The preferred wool group and the preferred acrylic group rated the mixture ratio as the main attribute that determined their preference, followed by the stitch length. The preferred long stitch length group considered stitch length as being the most important attribute, followed by the mixture ratio. The difference in the preferences for the mixture ratio and stitch length of knit fabrics was the highest between the three clusters. The preferred wool group preferred a knit fabric that has a greater wool mixture ratio and a short stitch length, and the preferred acrylic group and long stitch length group preferred a knit fabric that had a higher acrylic mixture ratio and a short stitch length.

Key words: Conjoint analysis, Benefit segmentation, Knit fabric, Preference; 컨조인트 분석, 효익세분화, 니트 소재, 선호도

I. Introduction

The trend toward a casual and sporty life style provides opportunities in new markets, even if overall consumption is shrinking and the apparel market is otherwise affected by an economic contraction. The demand for casual and sports clothing products and items has increased and market growth in casual and sports wear has extended the consumption of knit products.

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As there is a demands among savvy consumers for knit products, product differentiation and advanced knit products must be offered to satisfy their desires. It is not possible in manufacturing products to satisfy the needs and desires of an unspecified number of individuals or to meet an individual's needs and desires. A segment is a subgroup of consumer sharing one or more characteristics that causes then to have similar knit product needs. Segmentation is the process of dividing a market into distinct segments that behave in the same way or have similar needs.

Research on knit fabric has mainly centered on the effect of knit fabric constituent characteristics on objective evaluation and subjective evaluation. The research into fabric has been limited to the relationship between constituent characteristics and hand or texture, between constituent characteristics and sensibility, between hand or texture and preference, and between sensibility and preference(Kim & Na, 1999; Kim & Na, 2005; Kim & Lee, 1996, 1997; Ko et al., 2003). Ju(2005) found differences in the texture and sensibility of knit fabric according to the wool/rayon mixture ratio. However, the mixture ratio did not affect the preference of the knit fabric. According to this research, the reason for this was the high deviation according to the individual. In research into the relationship between the constituent characteristics and subjective evaluation(Roh & Ryu, 2007), the weight of fabric did not affect the preference of fabrics directly, but it affected preference indirectly through paths, such as weight→texture→sensibility→preference, or weight→sensibility→preference. In this respect, the reason for the noneffect of constituent characteristic on preference is that it has no regard for preference of the various individual's needs and desires. Roh & Kim(2007, 2008) applied conjoint analysis to measure the utilities of mountaineering jackets. They made predictions concerning consumers' purchase intentions in response to changes in the attributes of high-performance fabrics and the market segments of mountaineering jackets could be identified according to preference of functional properties. Knit markets can be segmented or targeted using a variety of constituent characteristics and segmented groups of consumers with varying needs and wants of knit constituent characteristics must be recognized. Understanding what constituent characteristics of knit fabrics are important for individual specific needs and requirement can make the designing of fabrics easier. In this regard, specialty knit markets will promote products more effectively than products aimed at the average consumer.

The objectives of this research were: to identify consumer segments in the market for knit fabrics, to compare the relative importance of the constituent characteristics(attributes) according to segmented clusters in terms of preference of knit fabric and to test if there were any significant differences in the preference of these clusters.

II. Methods

1. Conjoint Analysis and Segmentation

Conjoint analysis is a method for measuring and modeling consumer preferences for multiattribute alternatives. It requires consumers to respond to descriptions of existing and possible new alternatives by indicating their preference or purchase intention for each of the alternatives using a given scale. Conjoint analysis has already been widely accepted by marketing researchers as a popular instrument for the measurement of consumer preferences. Typical applications of conjoint analysis include new product design based on the relationship between product features and predicted choice behavior, and benefit segmentation based on attribute preferences(Gustafsson et al., 2003; Oppewal & Vriens, 2000).

This approach assumes that the part-worth of each attribute level is independent, and that the total utility is the sum of the attribute level of part-worths. Regarding the model specification, the total preference is calculated using the equation below:

$$T \cdot P = C + UM_i + US_j$$

where $T \cdot P$=total preference, C=constant, UM_i=the utility of level i from the mixture ratio, and US_j=the utility of level j from the stitch length.

Segmentation in conjoint analysis is accomplished in one of two ways. A priori segmentation approach

is one in which the marketing manager has decided on the appropriate basis for segmentation in advance of doing any research on a market. Segmentation is then conducted to determine the size of each of these groups and their demographic or psychographic profiles. However, problems typically arise in practice, since heterogeneous utility functions are rarely attributed to demographic or psychographic background information. Post hoc segmentation is an approach in which people are grouped into segments on the basis of research finding. For example, people interviewed concerning their attitudes of benefits sought in a particular product category are grouped according to their response(Gustafsson et al., 2003; Moore, 1980; Peter & Donnelly, 1985).

The specific model used in this research was estimated at the individual level using conjoint analysis. The individual level results were subsequently entered into the clustering procedure. To understand how attitudes affect preference statistical techniques such as cluster analysis are used where consumers with similar attitudes are combined together. As advanced knowledge of the number of clusters was not available, an agglomerative hierarchical method identified the most appropriate number of clusters to be formed, and then K-means cluster fine-tuned the results(Roh & Kim, 2007).

2. Test Fabrics

This research is the following of Roh & Ryu (2008). The properties of preply single yarns for knitting are shown in <Table 1>. This research was concerned with the constituent characteristics that influenced the preference of knit fabric that could be easily controlled. In Ju's(2005) research, the mixture ratio and stitch length of knit fabrics has a greater impact on subjective evaluation than other constituent characteristics. Therefore knit fabrics were made that could be controlled subjective texture and sensibility using the mixture ratio and stitch length.

The mixture ratio was regulated by plying two types of single yarn without twist: wool yarns and acrylic yarns, having similar yarn counts. The levels chosen in our research for the W/A mixture ratio were: 100/0, 75/25, 50/50, and 25/75.

The fabrics were knitted with a plain stitch and with a regular loop length according to yarn count by means of a Digital Stitch Control System established using a computer-controlled automatic flat knit machine (NEW SES 123 SI, Shima Seiki Mfg. Ltd., Japan) that was designed for 10 gauge whole garments.

Twelve knit fabrics were made using all four mixture ratios and three stitch lengths ranging from 7.4 to 9.0mm; a 8.2mm stitch length is standard for most knit-wear goods, as shown in <Table 2>.

3. Subjective Evaluation and Data Analysis

To evaluate the subjective preference of the knit fabric regarding the use of sweater, vest and cardigan, a respondent of women aged 20~30 years old rated knit fabrics by touch, using a questionnaire employing a 7-point unipolar scale. A preliminary test was conducted by 20 graduate students on cloths during 2007.7 and the results were validated. In the main test, 54 trained panelists, who were designers, lecturers, graduate students, and researchers who specialized in cloth, and 54 untrained panels, who were housewives, office workers, and graduate students, were also asked to perform the rating during 2007. 8. Only 93 cases were available for analysis, because some values were missing, and because some responses had the same rating for the 12 knit fabrics.

The conjoint data were analyzed using the SPSS conjoint software package.

III. Results and Discussion

1. Adequacy of the Conjoint Model

A post hoc segmentation analysis was carried out

Table 1. Properties of the single yarns

Fiber	Yarn count (Nm)	Twist number (t.p.m)	Twist direction	Remark
Wool 100%	32	440	Z	Hyundai Wool Textile Co.
Acrylic 100%	36	350	Z	Taekwang Industrial Co.

Table 2. Properties of the knit fabrics

Knit	Mixture ratio (W/A)	Stitch length (mm)	Thickness (mm)	Weight (g/m^2)	Fabric count	
					Wale/5cm	Course/5cm
A	100/0	9.0	0.21	283.2	27.4	22.1
B	100/0	8.2	0.25	323.8	31.1	24.5
C	100/0	7.4	0.27	336.1	35.4	26.9
D	75/25	9.0	0.26	269.0	27.6	22.2
E	75/25	8.2	0.28	322.1	30.6	24.6
F	75/25	7.4	0.28	361.8	35.0	26.7
G	50/50	9.0	0.27	260.0	27.2	22.4
H	50/50	8.2	0.28	295.4	20.1	24.7
I	50/50	7.4	0.28	324.7	35.1	26.7
J	25/75	9.0	0.30	278.3	26.9	22.4
K	25/75	8.2	0.30	293.5	30.6	24.5
L	25/75	7.4	0.31	316.3	35.6	26.4

W: Wool, A: Acrylic

Table 3. Characteristics of respondents

Category		Cluster I		Cluster II		Cluster III		Total group	
		N	%	N	%	N	%	N	%
Group	Trained	12	27.3	21	47.7	11	25.0	44	47.3
	Untrained	11	22.4	22	44.9	16	32.7	49	52.7
Age	20~29	13	21.0	33	53.2	16	25.8	62	66.7
	30~39	10	32.3	10	32.3	11	35.5	31	33.3
Total		23	24.7	43	46.2	27	29.0	93	100.0

Table 4. Adequacy of conjoint model

Cluster	Pearson's R	Kendall's tau
Total group (N=93)	0.974***	0.909***
Cluster I (N=23)	0.958***	0.718***
Cluster II (N=43)	0.970***	0.909***
Cluster III (N=27)	0.989***	0.779***

***$p<.001$

using all the attribute ratings to ascertain if clearly defined clusters of consumers existed. A three-cluster solution was found to have the best fit to the data. <Table 3> shows characteristics of respondents for the clusters and Cluster I contained 23 respondents, Cluster II contained 43 respondents, and Cluster III contained 27 respondents. Many respondents were distributed throughout Cluster II, and the respondents were distributed across Clusters I, II, and III, irrespective of profession and age.

Conjoint analysis was conducted for each cluster, and for the clusters overall. <Table 4> shows the Pearson's R and Kendall's tau statistics for these models. The Pearson's R correlation was recorded for all the observed and estimated preferences, and the Kendall's tau correlation coefficient(1.0) shows the extent of this correlation. Statistical data having a value close to 1.0 indicated that the models of Clusters I, II, and III, and of the overall 93 respondents, had good fits.

2. Market Segmentation

Based on the preference ratings, a conjoint analysis procedure calculated the contribution of each knit

fabric's attribute to a given respondent's preference. The contribution of the attribute level was denoted as its "part-worth utility". The part-worth utility scores showed the degree of preference. In other words, the utility scores described the desirability of the various levels of an attribute, with higher scores suggesting that the respondents had a greater preference for that particular knit fabric. <Fig. 1> and <Table 5> shows

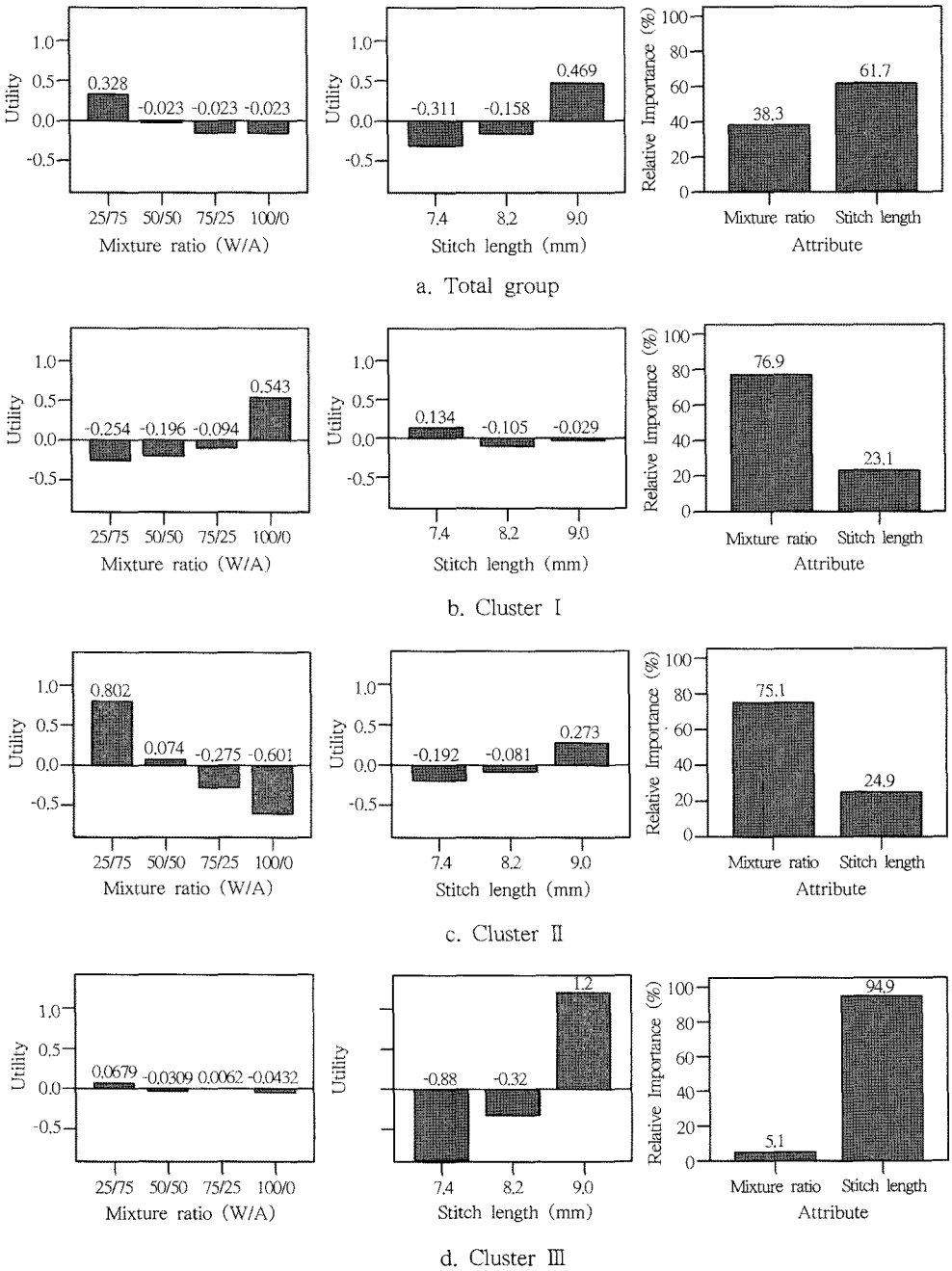

Fig. 1. Part-worth utilities and relative importance for total group and three clusters.

Table 5. Difference in utilities between clusters

Attribute	Level	Utility			F-value
		Cluster I	Cluster II	Cluster III	
Mixture ratio (W/A)	100/0	0.5435 a	-0.6008 c	-0.0432 b	31.21***
	75/25	-0.0942	-0.2752	0.0062	2.12
	50/50	-0.1957	0.0736	-0.0309	1.66
	25/75	-0.2536 c	0.8023 a	0.0679 b	30.62***
Stitch length (mm)	9.0	-0.0290 c	0.2733 b	1.2037 a	50.48***
	8.2	-0.1051	-0.0814	-0.3241	2.11
	7.4	0.1341 a	-0.1919 b	-0.8796 c	28.80***
Constant		4.1377	4.0116	3.6481	

***$p<.001$

the clusters of the part-worth utilities and their relative importance.

In the total group, the stitch length among the constituent characteristics of the knit fabrics was the most important attribute, and the mixture ratio of the knit fabrics was considered to be the least important attribute. In other words, the stitch length affected the preference for the knit fabric better than the mixture ratio did. Regarding the utility of the mixture ratio, a value of W/A 25/75 was considered to have the highest utility, followed by W/A 50/50, W/A 75/25, and W/A 100/0. The relationship between the mixture ratio of wool and the utility had a negative linear correlation. The more the mixture ratio of acrylic increased, the more the preference for the knit fabric increased. Regarding the utility of the stitch length, a stitch length of 9.0mm was considered to have the highest utility, followed by a stitch length of 8.2mm, and a stitch length of 7.4mm. The relationship between stitch length and the utility had a positive linear correlation. As the stitch length increased, the respondents showed a greater preference.

In Cluster I, the mixture ratio was the most important attribute, followed by the stitch length. The mixture ratio affected the preference of the knit fabric three times more than the stitch length did. Regarding the utility of the mixture ratio, a value of W/A 100/0 was considered to have the highest utility, while a value of W/A 25/75 was considered to have the lowest utility. The relationship between the mixture ratio of wool and the utility showed a positive linear correlation. As the mixture ratio of wool increased, the more a preference for the knit fabric increased. Regarding the utility of the stitch length, a stitch length of 7.4mm was considered to have the highest utility, followed by a stitch length of 9.0mm, and a stitch length of 8.2mm. The data in <Fig. 1(b)> shows that the relationship between the stitch length and the utility was described by a nonlinear model.

In Cluster II, the mixture ratio was the most important attribute, followed by the stitch length. The relative importance of the knit fabric for Cluster II was similar to that for Cluster I, but the utility of Cluster II showed an opposite tendency. Unlike Cluster I, a value of W/A 25/75 was considered to have the highest utility, whereas a value of W/A 100/0 was considered to have the lowest utility. The relationship between the mixture ratio of wool and the utility had a negative linear correlation. The more the mixture ratio of acrylic increased, the more the preference for the knit fabric increased. Regarding the utility of the stitch length, the relationship between the stitch length and the utility had a positive linear correlation. The respondents had a preference for a longer stitch length.

Unlike Clusters I and II, the stitch length was more important for Cluster III than the mixture ratio of the knit fabric. The mixture ratio hardly affected a preference of knit fabric, and there was no difference for Cluster III between the utility of the mixture ratio. Regarding the utility of the stitch length, the relationship between the stitch length and the utility had a positive linear correlation.

These results show that Cluster I considered the

wool mixture ratio to be more important than any other constituent characteristic of the knit fabrics, while the acrylic mixture ratio was regarded as being the most important attribute for Cluster II with respect to the relative importance values of each attribute. In addition, Cluster III considered a long stitch length to be the most important. Therefore, the clusters were named as follows: Cluster I was the preferred wool group, Cluster II was the preferred acrylic group, and Cluster III was the preferred long stitch length group. The results seemed to be affected by season. Although season had an effect, consumer segments were identified. The results mean that there are different preferences as to various constituent characteristics of knit fabrics.

In previous research into fabrics(Ju, 2005; Roh & Ryu, 2007), the constituent characteristics of a fabrics were found to hardly affect the preference of knit. In addition, these studies were not able to explain the direct relationship between the constituent characteristics of fabrics and the preference. The constituent characteristics of fabrics affected preference differently according to the cluster studied. This result shows that the market consisted of segmented clusters that shared similar preferences for the constituent characteristics of knit fabrics. This means that the development of fabrics must be varied to satisfy the needs of specific consumers.

3. Verification for Difference of Preference

An ANOVA analysis was carried out using the individual-level utilities data to discern the significance of any differences in the utility values of the clusters. ANOVA analysis at the 0.05 significance level was performed, and the results are listed in <Table 5>. Regarding the mixture ratio, there was no statistical difference in utilities for W/A 75/25 and W/A 50/50 between the clusters. However, differences in utilities for W/A 100/0 and W/A 25/75 between the clusters were significant. Cluster I had a higher utility for the W/A 100/0 mixture ratio than Clusters II and III did, and Clusters II had a higher utilityfor the W/A 25/75 mixture ratio than Clusters I and III did. Regarding the stitch length, there was no statistical difference in utilities for a stitch length of 8.2mm between the clusters. However, a difference in utilities for stitch lengths of 9.0mm and 7.4mm between the clusters was significant. Cluster III had a higher utility for a stitch length of 9.0mm than Clusters I and II, and Clusters I had a higher utility for a stitch length of 7.4mm than Clusters II and III. There was no statistical difference in the middle level utilities between the clusters. However, the differences in utilities for extreme levels between clusters were significant. There were different groups who preferred different constituent characteristics and different levels. Therefore, research into the relationship between constituent characteristics and a subjective evaluation including texture, sensibility, and preference according to clusters will be necessary in the future.

4. Preference for Knit Fabrics

The part-worth utility data shown in <Table 5> were summed to provide the total preference for all combinations of the constituent characteristic levels. <Table 6> shows the total preference scores and ranks, which were estimated using conjoint analysis, for total group, Cluster I, Cluster II, and Cluster III. The total preference ranged from 3.2189 to 5.0872.

Knit J was ranked first by total group, Knit G second, and Knit A third. The remaining knits were ranked according to the respondents' total preference. As expected, Knit J, which had a wool mixture ratio of W/A 25/75 and a stitch length of 9.0mm, was the most preferred knit. Knit F, which had a wool mixture ratio of W/A 75/25 and a stitch length of 7.4mm, was the least preferred knit.

Knit C was ranked first by Cluster I, Knit A second, and Knit B third. Knit C, which had a wool mixture ratio of W/A 100/0 and a stitch length of 7.4 mm, was the most preferred knit. Knit K, which had a wool mixture ratio of W/A 25/75 and a stitch length of 8.2mm, was the least preferred knit.

Knit J was ranked first by Cluster II, Knit K second, and Knit L third. Knit J, which had a wool mixture ratio of W/A 25/75 and a stitch length of 9.0mm, was the most preferred knit. Knit C, which had a wool mixture ratio of W/A 100/0 and a stitch length

Table 6. Preference scores and ranks for knit fabrics

Knit	Mixture ratio (W/A)	Stitch length (mm)	Total group		Cluster I		Cluster II		Cluster III	
			T-P	Rank	T-P	Rank	T-P	Rank	T-P	Rank
A	100/0	9.0	4.2553	3	4.6522	2	3.6841	8	4.8086	4
B	100/0	8.2	3.6500	8	4.5761	3	3.3294	11	3.2808	8
C	100/0	7.4	3.4527	11	**4.8153**	**1**	**3.2189**	**12**	**2.7253**	**12**
D	75/25	9.0	4.2378	4	4.0145	7	4.0097	5	4.8580	2
E	75/25	8.2	3.6325	9	3.9384	8	3.6550	9	3.3302	6
F	75/25	7.4	**3.4352**	**12**	4.1776	4	3.5445	10	2.7747	10
G	50/50	9.0	4.3851	2	3.9130	9	4.3585	4	4.8209	3
H	50/50	8.2	3.7798	7	3.8369	11	4.0038	6	3.2931	7
I	50/50	7.4	3.5825	10	4.0761	5	3.8933	7	2.7376	11
J	25/75	9.0	**4.7114**	**1**	3.8551	10	**5.0872**	**1**	**4.9197**	**1**
K	25/75	8.2	4.1061	5	**3.7790**	**12**	4.7325	2	3.3919	5
L	25/75	7.4	3.9088	6	4.0182	6	4.6220	3	2.8364	9
Constant			3.9583		4.1377		4.0116		3.6481	

of 7.4mm, was the least preferred knit.

Knit J was ranked first by Cluster III, Knit D second, and Knit G third. The most preferred knit and the least preferred knit were the same for Cluster II and III. However, there was a difference between the ranking of Clusters II and III. We can analyze the part-worth utilities of each of the attributes to ascertain how to increase the consumer's utility according to the clusters. For example, using the wool mixture ratio of Cluster I, the highest utility was obtained for a wool mixture ratio of W/A 75/25 for Knit D than a wool mixture ratio of W/A 50/50 for Knit I, whereas the utility of stitch length of 9.0mm for Knit D was lower than the utility of a stitch length of 7.4mm for Knit I. Cluster I showed a higher preference score for Knit I than Knit D.

With an understanding of the relative importance of an attribute and the impact of specific levels according to the clusters, it is possible to satisfy consumer's needs by predicting the market share.

IV. Conclusions

This research was conducted to gain a better overall understanding of segmented consumers with various needs and wants for knit fabrics. We used an experimental design incorporating conjoint analysis and cluster analysis to estimate and compare preferences for knit fabrics between segmented clusters.

There were three clusters with different preferred knit fabrics. The wool mixture ratio was the most important attribute for Cluster I, followed by stitch length. The acrylic mixture ratio was the most important attribute for Cluster II, followed by stitch length. The stitch length mixture ratio was the most important attribute for Cluster III, followed by mixture ratio. Cluster I was the preferred wool group, Cluster II was the preferred acrylic group, and Cluster III was the preferred long stitch length group. There was a difference in the preferred constituent characteristic of the knit fabric, and in the preferred level of constituent characteristic according to the clusters.

Following these results, consumer segments were identified. Therefore, the following will determine if there are significant differences in subjective textures and sensibility according to the segments. Demographic characteristic variables such as income, education, and so on, can be applied to explain segmented cluster characteristics. However, as only job and age of respondents were included in the questionnaire of this study, there are limitations as to how on might explain the demographic characteristics of consumers on the segmented market. Consumer characteristics in a segmented market can be explained in

terms of their needs and desires using various demographic characteristic variables in the succeeding research. As such, it is possible that fabric designing can be carried out more effectively.

However, This research shows the relevance of conjoint analysis as an effective analytical tool for the identification of consumer segments and important constituent characteristics of knit fabrics according to consumer segments, and its potential to provide substantial information on effective planning and designing of knit fabrics.

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요 약

개개인은 다른 이유를 가지고 동일한 또는 유사한 제품들을 구매한다. 추구 효익이란 동일한 속성에 동일한 상대적 중요성의 수준을 가지는 사람들을 군집하여 이러한 차이를 이해하려는 것이다. 본 연구에서는 니트 소재의 구성특성에 대한 추구 효익에 따라 소비자들을 세분화하고, 컨조인트 분석을 이용하여 선호도에 대한 구성특성들의 상대적 중요성을 비교·분석하여 세분화 집단에 따른 선호도에 유의한 차이가 있는지 분석하였다. 효용도에 따라서 양모 섬유를 선호하는 집단, 아크릴 섬유를 선호하는 집단과 긴 편환장을 선호하는 집단, 세개의 군집이 도출되었으며, 이들은 다른 구성특성의 이상적인 니트 소재를 선호하는 것으로 나타났다. 군집들 간에 니트 소재의 혼용률과 편환장에 대한 선호도에 유의한 차이가 있는 것으로 나타났다. 양모 섬유를 선호하는 집단은 양모 혼용률이 크고 짧은 편환장을 선호하였으며, 아크릴 섬유를 선호하는 집단과 긴 편환장을 선호하는 집단은 아크릴 혼용률이 크고 긴 편환장을 선호하였다.