DEPENDENCE OF PRICKLE ON MAGNITUDE OF FABRIC AREA AND NUMBER OF SEAM

Akira Morikawa†, Kana Watanabe and Asuka Maruyama

Department of Fashion Technology, Faculty of Fashion Science, Bunka Women's University,

3-22-1 Yoyogi, Shibuya-ku, Tokyo 151-8523, Japan

Introduction

The prickle is one of the most unpleasant tactile sensation evoked by fabrics. Naylor *et al.* reported that the fiber end greater than 32 μm in diameter on a wool fabric is a key factor evoking prickle sensation. However, less report has been made on the prickliness expressed in a clear function of the texture of fabrics.

The skin of the body wearing a cloth is in close contact not only with the surface of the fabric but also with the part of seam formed on the cloth. When the seam is formed on the cloth, the fabric is folded and the fiber ends may stand up more along the seam than on the flat area of the fabric. Therefore, the degree of prickle sensation must be dependent on both the magnitude of a fabric area and the number or length of seam.

In the present paper, the result of the sensory test of one kind of fabric having prickly stimulation will be exhibited for the different area of the fabric and the different number of seam formed between the fabric and a smooth jersey.

Experimental

The test piece for stimulation was made in the form of a neck-warmer belt. The belt was made of a smooth jersey of cotton, shown in Fig.1, into which stripes of a shaggy fabric(90% wool and 10% Nylon), shown in Fig.1, with various width and separation were sewn in a certain number of the stripe, as shown in Fig.2. Two series of belts, A and B with belt width of 8cm and 9cm, respectively, were prepared as summarized in Table 1. Both ends of the belt were terminated with adhesion tapes to be put on the neck of subjects for testing, and its length was to be adjustable to fit it 5 cm longer than the perimeter of the subject neck.

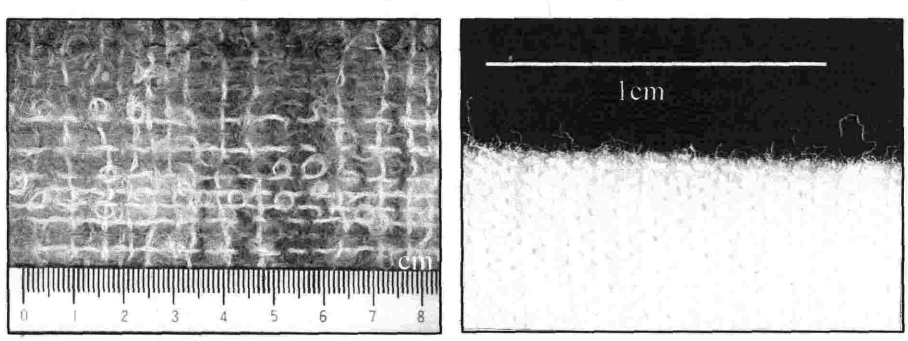

Fig.1. Shaggy(left) and jersey(right) fabrics used to make the test pieces.

† Corresponding author: morikawa@bunka.ac.jp

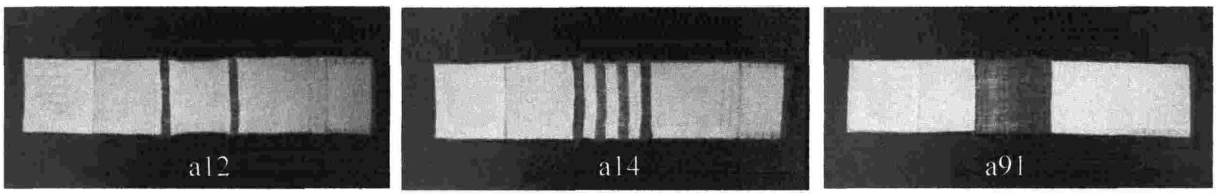

Fig.2. Examples of the test pieces of neck-warmer form, a12, a14 and a91 in Table 1.

Table 1. Preparation of the test piece like a neck-warmer belt.

Series A : 9cm belt width.									
Test piece No.	a11	a12	a13	a14	a15				a91
Stripe width (cm)	1	1	1	1	1				9
Number of stripe	1	2	3	4	5				1
Area (cm^2)	9	18	27	36	45				81
Number of seam	2	4	6	8	10				2
Stripe separation (cm)	-	7	3	1.7	1				-
Series B : 8cm belt width.									
Test piece No.		b12	b13	b14	b15	b21	b31	b41	b51
Stripe width (cm)		1	1	1	1	2	3	4	5
Number of stripe		2	3	4	5	1	1	1	1
Area (cm^2)		16	24	32	40	16	24	32	40
Number of seam		4	6	8	10	2	2	2	2
Stripe separation (cm)		1	1	1	1	-	-	-	-

The pieces named a11~a15 and b12~b15, are denoted by "Striped" test pieces and, while the others, b21~b51 and a91, by "Flat" test pieces in the following.

The sensory test of "Test I" was performed for 30 female subjects of the Bunka Women's University students with the test pieces of Series A, and that of "Test II" for the 15 students with Series B and the test piece a91. The data have been analyzed by Scheffe's paired comparison method—Nakaya's modification, with evaluation by a three grade scale for the difference of prickle sensation, 0, 1, 2. The sensory evaluation was performed on the subject's fore neck and rear, and in static condition and in a cool of motions, neck-bending forth and back followed by -twisting right and left, one time each.

Results and Discussion

The data analysis for the "Test I" showed 1% significant level for the main effect of the test pieces, as summarized in Table 2. The range of the main effect values for various fabric areas is much wider for the fore neck test than for the rear, indicating the rear neck is much less sensible

for prickliness than the fore neck. The range is also wider for the test in motion than in static, meaning the former test is more effective to distinguish the prickliness between two test pieces. Therefore, the test in the following was performed only for the fore neck in motion.

Table 2. The main effect values of the test pieces for Series A by the analysis of Scheffe's paired comparison method. (1% significant levels)

Test condition		Jersey	a11	a12	a13	a14	a15	a91
Fore neck.	In static.	-1.07	-0.58	-0.50	0.17	0.31	0.97	0.70
	In motion.	-1.23	-0.81	-0.49	0.14	0.41	1.24	0.75
Rear neck.	In static.	-0.30	-0.23	-0.15	-0.01	0.13	0.36	0.20
	In motion.	-0.51	-0.27	-0.15	-0.10	0.14	0.51	0.37

The main effect value of a91 is smaller than a15, although the area of the former is much lager than a15. A difference in these is only the number of seam, where a15 has ten seams and a91 only two. If rather great effect of the seam on the prickle may exist, "Striped" in Series B must show a higher main effect than "Flat" even though the area of the shaggy fabric is same.

Table 3. The main effect values of the test pieces for Series B and a91 by the analysis of Scheffe's paired comparison method. (1% significant levels)

Striped	b12	b13	b14	b15	
	-0.57	-0.27	0.52	1.07	
Flat	b21	b31	b41	b51	a91
	-0.62	-0.43	-0.25	-0.02	0.58
Difference	0.05	0.16	0.77	1.09	

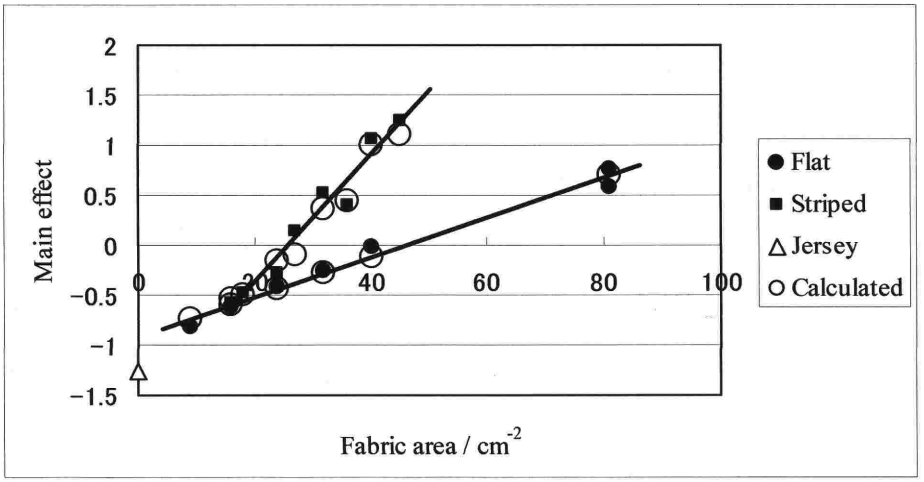

Fig.3. Dependence of the main effect values on the magnitude of fabric areas.

The main effect data obtained for the Series B are summarized in Table 3. It is stressed that the main effect value is increased with increase of the fabric area, as shown in Tables 2 and 3. A common sample, a91, for the independent tests, Tests I and II, exhibits similar values of the main effect, 0.75 and 0.58, respectively, indicating that data obtained from both Tests must be treated as one set, as shown in Fig.3. The test pieces are divided into two groups(Fig.3), the Flat test pieces and the Striped test pieces. Thus, the main effect value for prickliness, y, has been correlated to the magnitude of the area of the fabric, x, as

$$y = 0.0644\,x - 1.659, \quad R^2 = 0.959, \quad \text{for the Striped test piece,} \qquad (1)$$

$$y = 0.0200\,x - 0.922, \quad R^2 = 0.985, \quad \text{for the Flat test piece.} \qquad (2)$$

The difference Δy between the main effect value for "Striped" and that for "Flat", with the same area(Table 3), is increased with the increase of the number of seam, z, as shown in Fig.4, and the correlation equation in the following reproduces well the data of the difference.

$$\Delta y = 1.874\,[\ \{(1 + (0.1538\,z)^4\}^{1/4} - 1\ ]; \qquad R^2 = 0.959 \qquad (3)$$

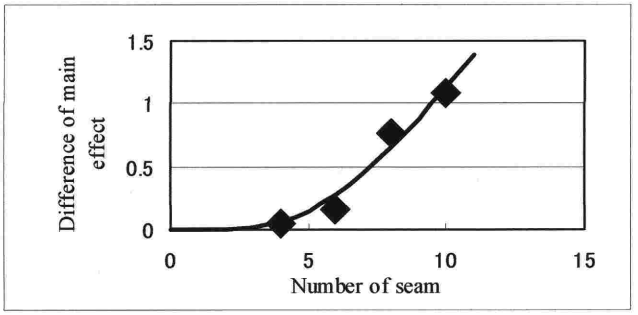

Fig.4. Dependence of the main effect value difference between "Striped" and "Flat" on the number of seam. The solid line corresponds to the values calculated by Equation (3).

It is, therefore, stressed that the degree of prickle, Y, is dependent on both the area of the shaggy fabric, X, and the number of seam, Z, and is calculated by an equation formed by combination of Equations (2) and (3) as follows.

$$Y = 0.0200\,X - 0.922 + 1.874\,[\ \{(1 + (0.1538\,Z)^4\}^{1/4} - 1]. \qquad (4)$$

This equation well reproduces the mean grade values of prickle sensation determined by the sensory test as shown by clear circles in Fig.3.

Conclusions

The degree of prickle sensation is dependent on both the magnitude of fabric area and the number of seam, and the main effect value of test pieces for prickliness obtained by Scheffe's paired comparison method is expressed by Equation (4). The application of a similar equation must be explored for many fabrics other than tested in the present work.

References

Naylor G.R.S., Phillips D.G., Veitch C.J., Dolling M. & Marland D.J. (1997). Fabric-Evoked Prickle in Worsted Spun Single Jersey Fabrics Part I: The Role of Fiber End Diameter Characteristics, *Textile Res. J.*, ***67***(4), 288-295.