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Differences in fabric hand perceptions among Japanese and Chinese individuals

Tomoharu Ishikawa and Junki Tsunetou
School of Engineering, Utsunomiya University, Utsunomiya, Japan
Yoshiko Yanagida and Mutsumi Yanaka
Faculty of Fashion Science, Bunka GAKUEN University, Shibuya-ku, Japan
Minoru Mitsui
Faculty of Technologists, Institute of Technologists, Gyoda, Japan
Kazuya Sasaki
Cooperative Faculty of Education, Utsunomiya University, Utsunomiya, Japan, and
Miyoshi Ayama
School of Engineering, Utsunomiya University, Utsunomiya, Japan

Abstract

Purpose – The study aimed to clarify differences in fabric hand perceptions among Japanese and Chinese participants and implement online shopping strategies that enable consumers to easily recognize fabric texture.

Design/methodology/approach – Forty (20 Japanese and 20 Chinese) participants knowledgeable about clothing and fabric were recruited. Participants evaluated fabric by sight and touch in a visuotactile experiment (VTE). The stimulus material comprised 39 fabric samples representing a broad range of fabric attributes (7 fibers, 5 weaving/knitting techniques and 3 yarn thicknesses and density). A Mann–Whitney *U* test and a factor analysis were conducted to determine differences in responses for the different fabric variables.

Findings – The fabric hand perceptions factors were similar between both groups. Japanese participants showed a stronger preference for fabrics that felt wet. Japanese participants' fabric hand perceptions had a 3-factor structure, while Chinese participants had a 2-factor structure. Chinese participants regarded "crisp" as perceptually and linguistically equivalent to "stretchy."

Originality/value – The study's findings suggest that Chinese people have stronger preferences in fabrics than Japanese people do. Japanese people evaluate fabric hand in a more nuanced manner than Chinese individuals, including discerning different fabric attributes, such as fiber and yarn thickness and density. Thus, nationality may influence fabric hand perceptions more than fabric knowledge does. Specifically, in evaluating "crispness," the results required further analysis because differences in nationality may have affected evaluations regarding perception and linguistic perspectives. The findings provide design guidelines for implementing online shopping strategies adapted to each participant group.

Keywords Fabric, Chinese, Japanese, Fabric hand perceptions

Paper type Research paper

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Introduction

The use of online shopping for clothing and fabrics is increasing, especially amid the COVID-19 pandemic (Aston *et al.*, 2020; Koch *et al.*, 2020). However, there is often a discrepancy between the texture of the cloth judged from a presented image vs that of the actual cloth. To address this issue, it is essential to clarify the mechanisms by which consumers judge fabric texture and thus employ images in online shopping that enable consumers to easily recognize fabric textures.

People's evaluations of fabric hand are shaped by several factors, including the fabric attributes, such as its weave or the thickness of the yarn, the perceptual information (such as tactile or visual information) regarding these attributes and the person's expertise in fabrics. There is a large body of literature on fabric hand. The pioneering studies in this area are those by Kawabata (1980) and Niwa (1990). Using standard fabric hand values provided by skilled technicians, these authors developed the "Kawabata Evaluation System for Fabrics" (KES-FB) to evaluate fabric hand based entirely on the mechanical properties of fabric. Subsequent studies examined how fabric hand evaluations are shaped by evaluator attributes, fabric attributes and perceptual modality and how these variables interact (Kobayashi, 1972; Nishimatsu and Sakai, 1987; Yashima *et al.*, 2017). However, few studies have considered the influence of the evaluator's expertise together with fabric and perceptual variables. A previous study (Tsunetou *et al.*, 2018) attempted to address this issue by examining how fabric hand evaluations were shaped by the evaluator's expertise, fabric attributes and perceptual modality. Participants were divided into experienced and less experienced groups and evaluated the fabric hand of varying attributes via two perceptual modalities: tactile and visuotactile. It was found that expertise level influenced fabric hand evaluations. Specifically, for both modalities, the hand evaluations of the experienced participants were likelier to result from an accurate analysis of the key fabric attributes and the tactile and visuotactile hand evaluations exhibited similarities. However, the study was limited in that the sample was solely Japanese.

Clothing industries aiming to globalize their production and sales may be interested in cross-cultural differences in fabric hand evaluations. For example, Stean *et al.* (1988) surveyed the summer-wear hand evaluations of judges in Japan, Australia, New Zealand, India, the US and China. According to a factor analysis, the Japanese and Chinese hand evaluations exhibited a factor structure that differed from the evaluations in other countries, and this was attributable to the mechanical properties of the fabrics. Moreover, Kim and Winakor (1996) examined the adjectives that American and South Korean consumers used to describe fabric hand. They reported that fabric perceptions were shaped by gender, culture and language, and that this was especially true for fabric preferences. Suehiro *et al.* (2014) examined how mechanical properties informed Japanese and Chinese participants' perceptions of a fabric's *"shittori,"* which is defined as a sensation similar to moisturized skin and semantically described as "baby's skin." Japanese participants perceived fabric as *"shittori"* if it used a knitting technique, featured a surface with frictional resistance and exhibited rigid shear, bending and low breathability. Contrastingly, Chinese participants perceived fabric as *"shittori"* if it featured gentle shear and bending. However, these studies focused on either a limited set of fabric attributes or a few evaluation parameters; for example, participants only evaluated the fabric regarding its intended use. Consequently, the effect of nationality on hand evaluations for fabrics of varying attributes remains unclear.

Method

The present study sought to determine cross-cultural differences in fabric hand perceptions. Twenty Japanese and 20 Chinese individuals, knowledgeable about clothing, were recruited. China was selected as the comparison nationality because the Chinese account for the largest proportion of the world's population and have many connections to Japan. Participants undertook one visuotactile experiment (VTE). The participants' responses were analyzed to determine intergroup differences regarding fabric attributes.

Experimental method

The fabric stimuli were stored for over 24 h in a standardized environment, with a temperature of 20°C and 65% humidity (Figure 1). Tests used a Judge II lighting booth (X-Rite, Grand Rapids). Each participant sat before the booth and evaluated the fabric therein. The booth was illuminated with a standard light source (D65). A total of 40 individuals participated: 20 Japanese (19 women, 1 man; aged 20–23 years) and 20 Chinese participants (19 women, 1 man; aged 21–30 years). Participants were students of Bunka Gakuen University and had formally studied fabrics and clothing. Informed written consent was obtained from all participants.

Figure 2 shows the experimental procedure. Participants washed their hands in preparation for the evaluation experiment, in which 39 types of fabrics were evaluated. One session was conducted with 13 types of fabric evaluation, and there were a total of three sessions, with 5-min breaks between them. The participants followed a standardized procedure when providing tactile evaluations of the fabric hand. This procedure mirrored

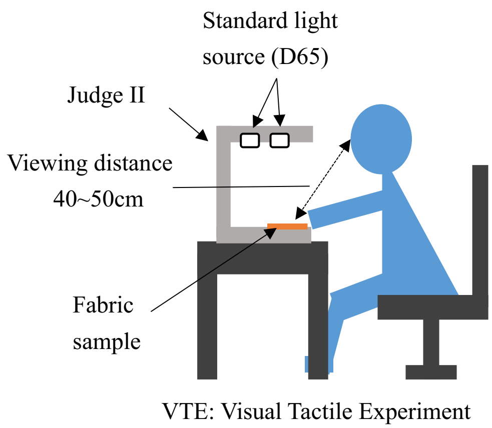

Figure 1.
Experimental environment

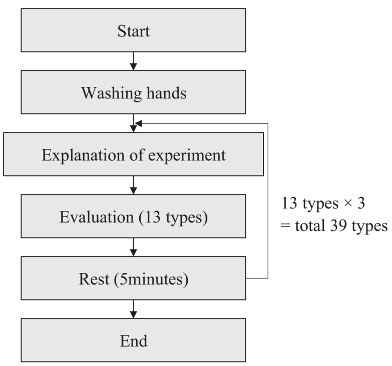

Figure 2.
Experimental procedure

Saito and Harada's (1987) three-step process (Figure 3). Upon completing these three steps, the participants rated how the fabric felt to touch. Participants could feel the fabric again and reconsider their rating if necessary, because we aimed for fabric hand ratings to be as accurate as possible. The scoring system consisted of a set of fabric hand descriptors rated on a 5-point scale, ranging from 0 = disagree to 4 = completely agree (Inoue, 2002, Figure 4). Nine descriptors were taken from Ishikawa *et al.* (2015): thin, thick, flat, rustic, soft, crisp, wet, dry and stretchy. We also added two thermal descriptors, two descriptors assessing participants' preference for the fabric and a visual descriptor: warm and cool, likeable and comfortable and shiny, respectively. The participants were provided sheets on which to state their ratings, with evaluation words randomly written for each subject. In addition, to control the meaning of each evaluation word, similar words examined in previous research (Ishikawa *et al.*, 2015) were summarized in a table and explained. For Japanese participants, the text was provided entirely in Japanese. For Chinese participants, the content was provided in Japanese, accompanied by a Chinese translation. The Chinese translation was carefully conducted by a Chinese-native clothing expert to preserve the meaning in the Japanese clothing field as much as possible.

Fabrics

The study used a total of 39 fabric stimuli representing various combinations of three fabric attribute variables: fiber, weaving/knitting and yarn thickness and density. The fibers used were cotton, hemp, wool, silk, cupro, nylon, or polyester. The weaving/knitting variable was plain weave (PW), twill weave (T), satin weave (S), plain stitch (PS), or rib stitch (R). The yarn thickness and density were classified as thick (T; >500 dtex and 38.3 ± 19.34 yarns/inch), medium (M; 250–500 dtex and 56.6 ± 23.98 yarns/inch), or fine (F: <250 dtex and 94.2 ± 45.05

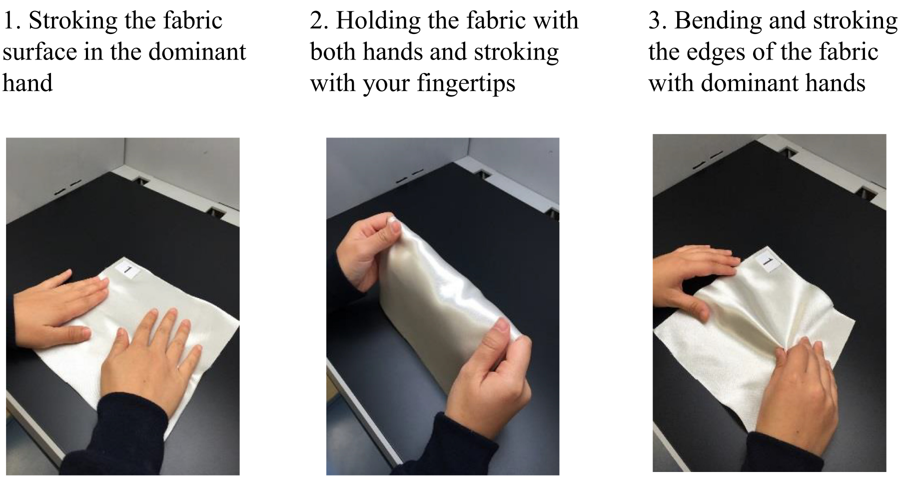

Figure 3.
Procedures of touching the fabric

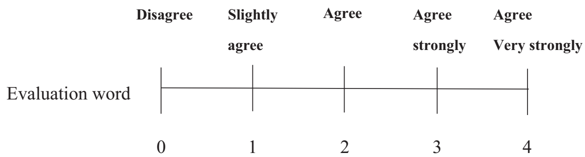

Figure 4.
Evaluation scale

yarns/inch). To control the influence of color on visual impression, only beige fabric samples were used. The dimensions were also standardized at 20 cm^2. Table 1 shows the mechanical properties of all 39 fabrics. These characteristics were measured using KES-FB Series (Katotech) [1].

Results

Evaluations results

Mann–Whitney U *test.* To compare the ratings between the Japanese and Chinese participants, a Mann–Whitney *U* test was conducted on the responses for the different fabric variables. Table 2 shows the results of the Mann–Whitney *U* test by fabric attribute. The results indicate significant intergroup differences in ratings for five of the descriptors (crisp, wet, cool, likeable and comfortable) regarding any or all fabric attributes. The significant intergroup differences for the descriptors are discussed below.

Wet. Figure 5 shows the Japanese and Chinese participants' average and standard deviation of "wet" ratings for each fiber represented by the symbols and error bars, respectively. The Japanese ratings and deviations are on the *X*-axis and that of the Chinese are represented on the *Y*-axis. The data suggest that Japanese participants mostly rated the fabrics as wetter than the Chinese participants did. However, the Japanese participants' standard deviation of evaluation for each fabric was larger than that of the Chinese participants. Only hemp fabric (indicated by a diamond in Figure 5) was rated as less wet by the Japanese participants.

Likeable. Figure 6 shows the intergroup responses for "likeable." The graph is plotted identically to the format in Figure 5. Figure 6 indicates that the Chinese rated more fabrics as "likeable" than the Japanese participants did; however, both groups' standard deviation of evaluation for each fabric material were large. Similarly, the Chinese participants deemed more fabrics with many fibers to be "comfortable" than did their Japanese counterparts. Accordingly, we examined whether the responses for "likeable" correlated with the responses for semantically similar descriptors. Table 3 shows the four comparative descriptors (soft, wet, comfortable and dry) that exhibited a strong correlation with "likeable" (the absolute value of the Pearson's correlation coefficient was >0.6 in each case). "Likeable" was strongly positively correlated with "soft," "wet," and "comfortable," and strongly negatively correlated with "dry," regardless of nationality and sensory modality (Table 3).

Crisp. Figure 7 show the intergroup responses for "crisp." The Japanese participants tended to perceive fabric as crisper if it was woven (plain, twill, or satin weave) than if it was stitched (plain or rib stitch). However, the Japanese participants' standard deviation of evaluation for each fabric weaving technique was larger than that of the Chinese participants. The "crisp" ratings of Chinese participants were strongly positively correlated with their ratings for "stretchy." Figure 8 depicts the Japanese and Chinese "crisp" and "stretchy" ratings for all 39 fabrics. The symbols represent the different weaving/knitting techniques. The figure shows correlations between each group's responses for "crisp" and "stretchy;" specifically, it was negative among the Japanese group ($R\_J = -0.76$) and strongly positive among the Chinese group ($R\_C = 0.97$).

Factors determining fabric hand perceptions

To determine how fabric hand perceptions were influenced by nationality (Japanese/Chinese), a factor analysis was performed on the results for each fabric according to nationality. The factor scores (termed "fabric hand spaces") were then analyzed. Specifically, we analyzed the nationality-related differences within a fabric hand space, derived from a combination ("VTE space") of Japanese ("Japanese space") and Chinese participants' ("Chinese space")

Fiber	Weaving knitting	Thickness of yarn	Tensile LT –	Tensile WT gf·cm/cm^2	Tensile RT %	Bending G gf/cm·degree	Bending 2HG gf/cm	Bending 2HG5 gf/cm	Shear B gf·cm^2/cm	Shear 2HB gf·cm/cm	Compression LC –	Compression WC gf·cm/cm^2	Compression RC %	Surface MIU –	Surface MMD –	Surface SMD μm	Thickness TO mm	Weight W mg/m^2
Cotton	PW	F	0.66	10.51	46.22	1.08	1.23	4.55	0.04	0.03	0.33	0.12	52.11	0.14	0.02	2.44	0.35	11.21
	PW	M	0.71	10.54	47.72	2.29	2.77	7.60	0.09	0.08	0.34	0.12	50.52	0.13	0.04	4.70	0.47	17.23
	PW	T	0.62	9.46	48.10	2.25	2.44	7.25	0.20	0.12	0.33	0.17	45.85	0.16	0.02	6.26	0.66	25.65
	T	F	0.66	10.67	44.60	1.68	3.30	8.26	0.08	0.08	0.41	0.28	36.53	0.16	0.01	2.00	0.60	16.25
	T	M	0.63	10.11	46.13	0.86	1.04	3.47	0.11	0.07	0.31	0.16	47.27	0.15	0.01	1.80	0.57	19.50
	T	T	0.60	10.63	44.09	1.00	1.26	3.77	0.17	0.14	0.39	0.16	46.29	0.15	0.01	2.67	0.70	26.89
	S	F	0.62	9.36	43.32	0.51	0.84	2.14	0.06	0.03	0.31	0.13	46.11	0.14	0.01	1.40	0.41	12.00
	S	M	0.65	9.43	45.19	1.11	1.91	4.60	0.14	0.10	0.33	0.18	44.28	0.15	0.01	1.54	0.67	23.53
	PS	F	0.83	9.28	32.02	0.80	2.77	3.05	0.02	0.02	0.32	0.26	39.44	0.17	0.01	2.86	0.74	13.94
	PS	M	0.87	8.01	32.22	0.77	3.18	3.47	0.03	0.03	0.32	0.29	37.07	0.20	0.01	3.44	0.86	16.03
	R	F	0.84	15.39	37.14	0.61	2.02	2.10	0.03	0.03	0.32	0.28	41.71	0.19	0.02	7.44	0.87	15.28
	R	M	0.96	8.54	33.59	1.12	4.66	5.33	0.14	0.13	0.31	0.32	39.33	0.22	0.04	7.17	1.36	31.19
Hemp	PW	M	0.59	13.16	29.46	0.26	0.16	0.53	0.16	0.09	0.28	0.18	37.74	0.16	0.03	7.81	0.57	15.84
	PW	T	0.61	14.30	35.28	0.30	0.19	0.66	0.22	0.11	0.42	0.26	41.62	0.19	0.03	9.22	0.69	21.90
	T	F	0.49	13.31	32.94	0.22	0.11	0.23	0.11	0.04	0.34	0.20	41.50	0.21	0.02	4.02	0.59	13.80
Wool	PW	M	0.59	12.22	65.99	0.53	0.31	1.13	0.06	0.02	0.33	0.08	72.25	0.17	0.04	5.99	0.39	16.06
	PW	T	0.51	11.68	56.41	0.54	0.94	1.83	0.18	0.06	0.39	0.17	62.42	0.16	0.01	5.32	0.74	25.64
	T	M	0.69	12.70	62.43	0.55	0.50	1.31	0.11	0.03	0.35	0.11	63.55	0.16	0.01	2.42	0.61	21.70
	T	T	0.51	10.44	52.65	0.49	0.97	1.63	0.14	0.05	0.42	0.26	66.73	0.16	0.01	2.90	0.83	24.62
	S	M	0.68	10.01	61.65	0.71	0.94	2.06	0.15	0.06	0.40	0.17	68.90	0.16	0.01	2.67	0.79	25.86
	PS	M	0.94	8.75	50.67	1.03	2.46	3.10	0.12	0.08	0.39	0.29	68.74	0.16	0.01	3.39	1.14	29.04
	PS	T	0.85	12.65	38.84	0.56	2.22	2.34	0.21	0.18	0.43	0.93	56.73	0.28	0.02	7.34	2.33	27.67
	R	M	0.74	7.18	54.36	0.57	1.01	1.19	0.07	0.04	0.40	0.74	61.97	0.26	0.02	8.69	1.90	26.19
Silk	PW	F	0.60	18.27	46.60	0.22	0.03	0.17	0.01	0.00	0.47	0.05	81.81	0.17	0.02	2.61	0.22	6.56
	T	F	0.58	3.93	68.37	0.23	0.18	0.40	0.04	0.02	0.46	0.04	76.61	0.16	0.01	0.89	0.16	6.39
	S	F	0.58	9.56	53.50	0.20	0.04	0.17	0.02	0.01	0.49	0.04	76.79	0.19	0.01	1.46	0.21	7.07
Cupro	PW	F	0.69	7.19	65.33	2.84	2.99	9.22	0.10	0.04	0.29	0.04	75.46	0.17	0.03	8.03	0.27	12.94
	T	F	0.72	4.24	71.40	12.17	23.65	30.24	0.79	0.27	0.50	0.03	91.45	0.19	0.04	7.49	0.33	20.29
	S	F	0.73	4.17	67.35	6.89	7.99	18.70	0.36	0.17	0.49	0.03	78.03	0.22	0.01	1.40	0.33	18.41

(*continued*)

Table 1. Fabric samples and mechanical characteristics

Fiber	Weaving knitting	Thickness of yarn	Tensile			Bending			Shear		Compression			Surface			Thickness	Weight
			LT	WT	RT	G	2HG	2HG5	B	2HB	LC	WC	RC	MIU	MMD	SMD	TO	W
			–	gf·cm/cm^2	%	gf/cm·degree	gf/cm	gf/cm	gf·cm^2/cm	gf·cm/cm	–	gf·cm/cm^2	%	–	–	μm	mm	mg/m^2
Nylon	PW	F	0.63	19.02	42.34	0.27	0.64	0.66	0.00	0.00	0.50	0.22	56.78	0.27	0.01	9.67	0.60	8.53
	PW	M	0.59	6.60	70.62	0.31	0.25	0.79	0.03	0.01	0.39	0.05	62.11	0.23	0.02	3.81	0.21	6.42
	T	F	0.64	10.90	57.34	1.16	1.36	4.63	0.04	0.03	0.31	0.05	65.21	0.29	0.01	0.65	0.32	17.45
	S	F	0.67	13.29	58.33	0.80	1.26	3.27	0.22	0.10	0.55	0.09	57.11	0.28	0.01	2.44	0.56	20.10
Polyester	PW	F	0.64	4.18	67.87	0.35	0.35	1.19	0.05	0.04	0.48	0.04	75.95	0.30	0.01	1.04	0.18	9.39
	T	F	0.77	25.04	55.47	0.39	1.01	1.02	0.01	0.01	0.50	0.15	48.51	0.35	0.02	2.73	0.68	23.28
	T	M	0.87	6.39	49.45	0.91	2.11	2.30	0.01	0.01	0.54	0.15	53.65	0.28	0.01	5.87	0.64	13.66
	S	F	0.70	6.18	64.03	0.25	0.21	0.57	0.05	0.02	0.42	0.02	129.00	0.20	0.02	1.30	0.10	6.60
	PS	F	0.66	4.69	68.56	0.22	0.12	0.35	0.04	0.01	0.36	0.02	115.13	0.17	0.02	1.40	0.10	6.66
	R	F	0.66	3.72	65.95	0.28	0.16	0.63	0.11	0.04	0.51	0.02	97.29	0.19	0.01	0.78	0.15	10.56

Table 1.

Category	Fiber	Weaving/knitting	Thickness of yarn
Thin	–	–	–
Thick	–	–	–
Flat	–	–	–
Rustic	–	–	–
Soft	–	–	–
Crisp	–	*	*
Wet	**	**	*
Dry	–	–	–
Stretchy	–	–	–
Warm	–	–	–
Cool	*	–	–
Likeable	**	**	**
Comfortable	**	**	**
Glossy	–	–	–

Note(s): *($p < 0.05$) **($p < 0.01$)

Table 2.
Results of Mann–Whitney U test

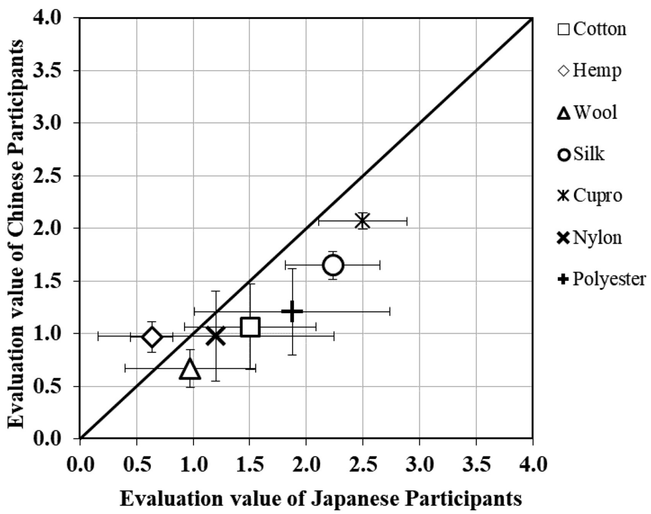

Figure 5.
Evaluation result of "Wet"

ratings. Using the principal factor method, factors exhibiting an eigenvalue of >1 were extracted, and varimax rotation was applied. Tables 4–6 show the results for each analysis, with bold font indicating factor loadings of descriptors that were closely associated with specific factors. The Japanese space presented a 3-factor structure: moist/preference, thermal sensation and flexibility. The Chinese space presented a 2-factor structure: thermal sensation and flexibility/preference. The VTE space presented a 3-factor structure: flexibility/preference, thermal sensation and surface. These factors were named based on the descriptors with the largest loadings.

Fabric hand spaces

Figures 9 and 10 show the Japanese and Chinese VTE space results, respectively. Although the VTE space had a 3-factor structure, we displayed only the first two factors in Figures 9 and 10 for

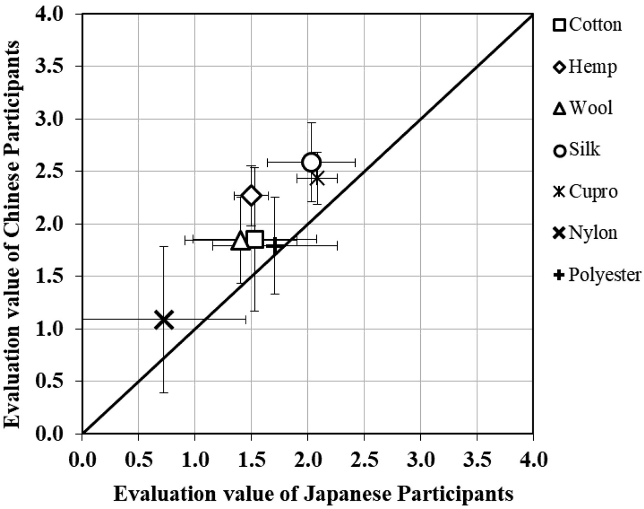

Figure 6.
Evaluation result of "likeable"

Table 3.
Correlations between "likeable" and other evaluation words

Subjects	Experiments	Soft	Wet	Comfortable	Dry
Japanese	TE	0.87	0.88	0.96	−0.8
	VTE	0.8	0.79	0.87	−0.78
Chinese	TE	0.82	0.68	0.92	−0.6
	VTE	0.84	0.67	0.91	−0.53

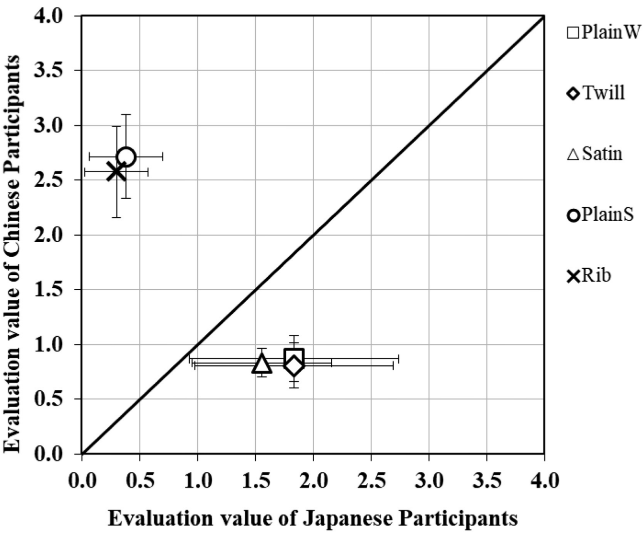

Figure 7.
Evaluation result of "Crisp"

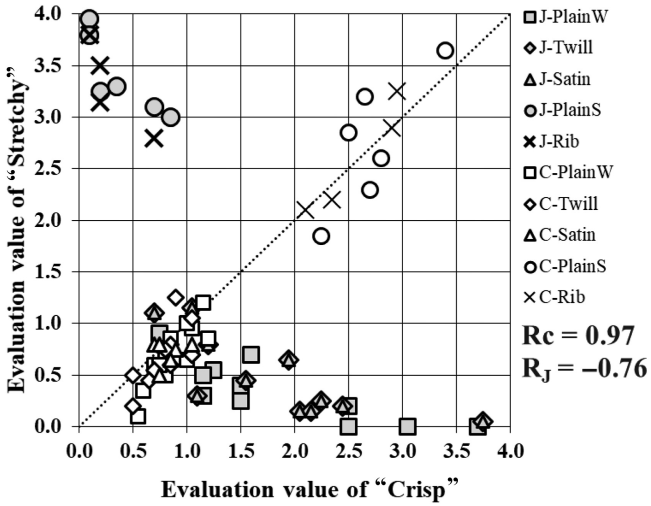

Figure 8.
Evaluation result of "crisp" and "stretchy"

clarity. Both figures show the fiber-specific factor scores plotted against the factor axes. Different values for a given fiber attribute are linked by each line to indicate their distribution range, termed "fiber spaces." The *X*-axis and *Y*-axis represent the Factor 1 and Factor 2 scores, respectively. The fabric symbols are as follows: ■ = cotton, ◆ = hemp, ▲ = wool, ● = silk, * = cupro, × = nylon and + = polyester. Table 7 shows the factor scores for Factors 1 and 2 for each fabric, that is, the x- and *y*-axis coordinates for each fabric, respectively, in Figures 9 and 10. The portion of a factor axis occupied by a fiber space describes how much the fabric attributes influenced the ratings. That is, if a fiber space extends across large sections of the axes, it implies that the participants keenly discerned these attributes when evaluating a specific fabric. To investigate further, the fiber spaces for the Japanese and Chinese participants were compared for each of the three factors ("factor width") in the VTE. Table 8 shows the results for VTE spaces. Differences in the overall area occupied by the fiber spaces were also examined. Table 8 displays the average

Evaluation words	Moist preference factor	Thermal sensation factor	Flexible factor
Wet	*0.870*	0.186	0.392
Dry	*−0.858*	−0.027	−0.364
Rustic	*−0.834*	−0.440	0.013
Comfortable	*0.782*	0.258	0.510
Flat	*0.699*	0.598	−0.254
Like	*0.685*	0.050	0.598
Cool	0.065	*0.892*	−0.102
Thick	−0.299	*−0.880*	−0.170
Thin	0.354	*0.875*	0.270
Warm	−0.062	*−0.868*	0.465
Crisp	−0.155	−0.003	*−0.953*
Soft	0.437	0.147	*0.871*
Stretchy	0.147	−0.288	*0.782*
Eigenvalue	4.219	3.850	3.573
Contribute ratio	32.45%	29.62%	27.49%
Cumulative contribute ratio	32.45%	62.07%	89.56%

Table 4.
Factor analysis result of Japanese space

Table 5.
Factor analysis result of Chinese space

Evaluation words	Thermal sensation factor	Flexible preference factor
Cool	*0.930*	0.091
Flat	*0.920*	0.092
Thin	*0.909*	0.143
Thick	*−0.894*	−0.013
Rustic	*−0.886*	−0.224
Warm	*−0.876*	0.396
Dry	*−0.842*	−0.349
Wet	*0.788*	0.461
Stretchy	−0.129	*0.869*
Comfortable	0.432	*0.824*
Crisp	−0.199	*0.808*
Like	0.324	*0.804*
Soft	0.480	*0.802*
Eigenvalue	6.797	3.957
Contribute ratio	52.29%	30.44%
Cumulative contribute ratio	52.29%	82.73%

Table 6.
Factor analysis result of VTE space

Evaluation words	Flexible preference factor	Thermal sensation factor	Surface factor
Soft	*0.955*	0.179	0.104
Comfortable	*0.846*	0.163	0.360
Like	*0.784*	0.060	0.228
Stretchy	*0.775*	−0.191	−0.275
Crisp	*−0.203*	−0.086	−0.069
Cool	0.134	*0.888*	0.194
Thick	−0.266	*−0.855*	−0.304
Warm	0.322	*−0.849*	−0.403
Thin	0.391	*0.834*	0.337
Flat	0.140	0.475	*0.819*
Rustic	−0.330	−0.354	*−0.779*
Glossy	−0.062	0.414	*0.725*
Dry	−0.633	−0.180	*−0.672*
Wet	0.603	0.161	*0.633*
Eigenvalue	4.125	3.623	3.333
Contribute ratio	29.47%	25.88%	23.81%
Cumulative contribute ratio	29.47%	55.35%	79.16%

results for factor width, factor width difference and area difference. Both factor width difference and area difference were determined by subtracting the average for the Chinese participants from that of the Japanese participants. Accordingly, a positive value describes differences in the factor width and fiber space for Japanese participants compared to Chinese participants. Conversely, a negative value describes such differences among Chinese participants compared to Japanese participants. The data in Figures 9 and 10 and Table 8 indicate that the factor width and area difference were greater among Japanese participants in all cases.

Discussion

Intergroup differences in strength of preference

The Chinese participants rated the fabrics as more likeable than the Japanese participants did (Figure 6), indicating that the participants' nationality affected their preferences for the fabrics. This is consistent with Kim and Winakor (1996), who reported that American and

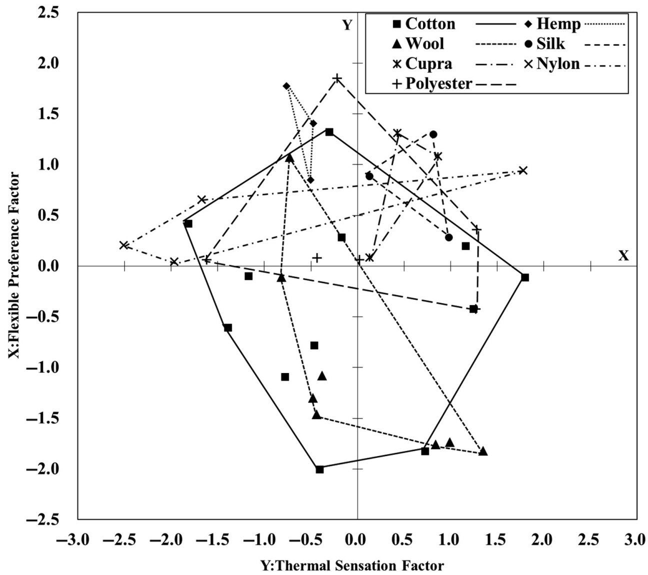

Figure 9.
Japanese VTE space

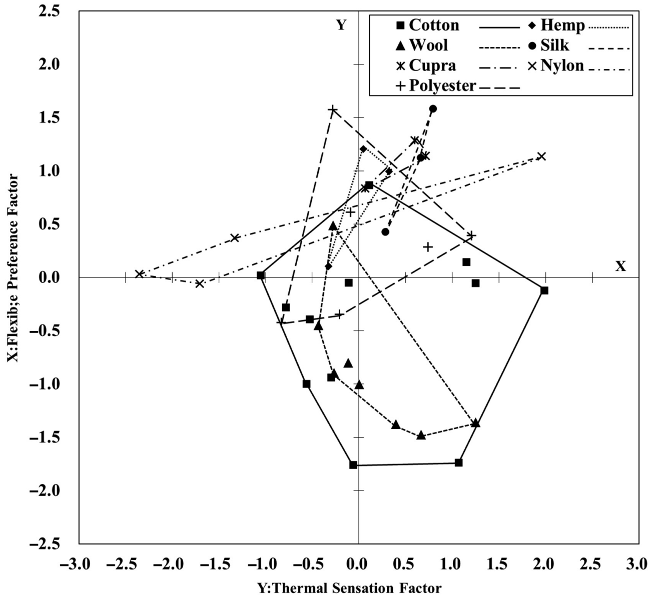

Figure 10.
Chinese VTE space

South Korean individuals differed regarding their strength of preference for fabrics. Moreover, both Japanese and Chinese participants associated likeability ratings with qualities of "soft," "wet," and "comfortable," and the opposite was true for "dry" (Table 3). Additionally, the associations of "likeable" with "wet" and "dry" were stronger among the Japanese participants. This may suggest that Chinese participants preferred soft fabrics,

Fiber	Weaving knitting	Thickness of yarn	Japanese X:Flexible preference factor	Japanese Y:Thermal sensation factor	Chinese X:Flexible preference factor	Chinese Y:Thermal sensation factor
Cotton	PW	F	−0.30	1.32	0.11	0.87
	PW	M	−1.81	0.42	−1.05	0.02
	PW	T	−1.39	−0.61	−0.56	−1.00
	T	F	−1.17	−0.10	−0.78	−0.28
	T	M	−0.46	−0.78	−0.53	−0.39
	T	T	−0.78	−1.09	−0.29	−0.94
	S	F	−0.17	0.28	−0.11	−0.05
	S	M	−0.40	−2.01	−0.06	−1.76
	PS	F	1.16	0.20	1.15	0.14
	PS	M	1.25	−0.42	1.25	−0.05
	R	F	1.80	−0.11	1.99	−0.12
	R	M	0.73	−1.83	1.07	−1.74
Hemp	PW	M	−0.76	1.78	0.05	1.21
	PW	T	−0.50	0.85	−0.32	0.10
	T	F	−0.47	1.41	0.32	0.99
Wool	PW	M	−0.73	1.07	−0.27	0.49
	PW	T	−0.48	−1.30	−0.11	−0.80
	T	M	−0.81	−0.11	−0.43	−0.45
	T	T	0.84	−1.76	0.40	−1.38
	S	M	−0.44	−1.46	−0.27	−0.90
	PS	M	0.99	−1.74	0.67	−1.48
	PS	T	−0.38	−1.08	0.00	−1.00
	R	M	1.35	−1.82	1.25	−1.36
Silk	PW	F	0.81	1.30	0.79	1.58
	T	F	0.13	0.88	0.28	0.43
	S	F	0.98	0.28	0.66	1.13
Cupro	PW	F	0.43	1.31	0.60	1.29
	T	F	0.86	1.08	0.72	1.14
	S	F	0.13	0.08	0.07	0.84
Nylon	PW	F	−1.67	0.66	−1.33	0.37
	PW	M	−2.51	0.21	−2.35	0.03
	T	F	−1.96	0.05	−1.71	−0.06
	S	F	1.78	0.94	1.96	1.14
Polyester	PW	F	−0.22	1.85	−0.28	1.57
	T	F	−0.44	0.08	−0.21	−0.35
	T	M	−1.62	0.06	−0.83	−0.42
	S	F	0.02	0.06	−0.09	0.61
	PS	F	1.28	0.36	1.21	0.39
	R	F	1.27	−0.42	0.74	0.29

Table 7.
Factor scores for factor 1 and factor 2 for each fabric

while Japanese participants favored both soft and moist fabrics. This is consistent with Suehiro *et al.* (2014), who reported that Japanese participants displayed a stronger preference for moist fabrics than Chinese participants did.

Intergroup differences in fabric hand spaces

The fabric hand space for Japanese participants (Table 4) presented a 3-factor structure, while that of Chinese participants (Table 5) presented a 2-factor structure. This is in line with Ishikawa *et al.* (2012), who analyzed Japanese and Chinese perceptions of high dynamic range (HDR) images and found that Japanese perceptions had a more complex factor structure. Notwithstanding the differences between the two studies, including the difference in stimuli, the findings suggest that

		VTE space			
	Name	Japanese	Chinese	Width difference	Area Difference
First Factor	Flexible Preference	2.107	1.838	0.268	0.822
Second Factor	Thermal Sensation	1.796	1.498	0.298	
First Factor	Flexible Preference	2.107	1.838	0.268	0.45
Third Factor	Surface Factor	1.677	1.355	0.323	
Second Factor	Thermal Sensation	1.796	1.498	0.298	0.117
Third Factor	Surface Factor	1.677	1.355	0.323	

Table 8. Difference in width of each fiber space and area (VTE space)

Japanese people perceive stimulus material in a more precise and nuanced manner than Chinese people do. Moreover, our results indicated that the fibers' factor width and area in VTE spaces was greater among the Japanese participants. Given that each fabric had different attributes (fiber, weaving/knitting and yarn's thickness and density), the factor width and space area can be regarded as indicative of how keenly the participants differentiated between these attributes when evaluating the fabrics. Thus, Japanese responses exhibited greater factor width and space area, implying that Japanese participants perceived these differences more acutely.

Perceptual and linguistic differences with "crisp" and "stretchy"

This experiment was conducted under strict control, with the Chinese fabric texture evaluation words carefully translated by a native Chinese textile expert to preserve the meaning. The descriptors "crisp" and "stretchy" were negatively correlated among Japanese participants, but positively correlated among Chinese participants (see Figure 8). This implies that Japanese participants differentiated between crisp and stretchy textures, while Chinese participants perceived crispness similarly to stretchiness. This may be due to sensory and linguistic differences in evaluation. Regarding the sensory perspective, research indicates that the sensations generated by presentation stimuli are influenced by cultural aspects, such as growth environment and lifestyle (Ishii *et al.*, 2009; Matsunaga *et al.*, 2018; Rhode *et al.*, 2016). Chinese participants have fewer opportunities and ways to distinguish between "crisp" and "stretchy" evaluations of fabrics than Japanese participants, and the sense of distinction was not cultivated. Therefore, "crisp" and "stretchy" were evaluated similarly. From the linguistic perspective, *hari-no-aru* ("crisp") is a unique Japanese expression regarding fabric. It is related to the texture described in Kawabata (1980) and was defined as a representative word for expressing complex sensations (Ishikawa *et al.*, 2015). Thus, it may have been evaluated as a synonym for "stretchy" because there was no direct translation in Chinese for *hari-no-aru*. The issue of semantic differences was highlighted by Kim and Winakor (1996), who asked American and South Korean participants to rate fabric stimuli using English and Hangul unipolar adjectives. Future research should address this issue. This finding represents an important discovery for designing subject-adaptive online shopping according to the relationship between the texture evaluation words of fabrics and their actual evaluations.

The influence of expertise compared with that of nationality

Tsunetou *et al.* (2018) examined how differences in sartorial knowledge affected fabric hand among Japanese individuals. They found that sartorially aware participants used their knowledge to discern differences in fabric attributes. Moreover, with the addition of visual information, the less knowledgeable participants struggled to discern the shear property as the visual information affected their tactile perceptions. Thus, differences in expertise may explain differences in fabric hand evaluations. The participants in our study were all students in clothing-related disciplines, but their nationality differed. Our results indicated that nationality explained numerous differences, including differences in fabric hand descriptors and the number of factors extracted in the factor analysis. Thus, the evidence suggests that differences in nationality affect perceived fabric hand more than differences in expertise do. The findings obtained in this paper are considered to provide design guidelines for realizing online shopping adapted to each subject group.

Conclusions

This study aimed to identify differences in the fabric hand perceptions between Japanese and Chinese participants. Fabric stimuli were tested on Japanese and Chinese participants in a visuotactile task. Significant intergroup differences in the ratings of "crisp," "wet," "cool," "likeable" and "comfortable" were found. The ratings for these descriptors were significantly influenced by all three fabric attribute variables (fiber, weaving/knitting and yarn thickness and density). The results for "crisp" suggested that sensory or linguistic interpretations differed among the groups and required further analysis. The results for "wet" revealed that Japanese participants rated the wetness of fabrics higher than their Chinese counterparts did although the reverse was true for the hemp fabrics. The results for the likeability descriptors ("likeable" and "comfortable") revealed that Japanese participants showed a stronger preference for moist fabrics. A factor analysis suggested that the Japanese fabric hand evaluations were more precise, nuanced and varied. This was indicated by the larger number of factors extracted, as well as the larger factor widths and fiber space areas for the Japanese cohort. Finally, we would like to implement online shopping that is adapted to more consumers.

Our study had three main limitations. First, all participants were in their 20s, which may result in finger sensitivity bias related to differences based on age and may have thus affected the fabric hand test results (Musa *et al.*, 2019). Second, the results may have been affected by cross-cultural differences (both linguistic and perceptual) regarding the fabric hand descriptors. When individuals with different native languages select or substitute descriptors, they must strive for perceptual and linguistic equivalence. They must discuss ways to maximize both equivalences while considering multiple perspectives. Finally, the number of participants was small, affecting the generalizability of our results. Accordingly, future studies must focus on conducting these experiments using a larger sample size to verify the reliability of the results obtained in the present study.

Note

1. Available at: https://english.keskato.co.jp/

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Corresponding author
Tomoharu Ishikawa can be contacted at: ishikawa@is.utsunomiya-u.ac.jp