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KUMAŞLARIN DOKUNMA HİSSİNE DAYALI DUYGUSAL İYİLEŞME ETKİSİNİN DEĞERLENDİRİLMESİ

EVALUATION OF EMOTIONAL HEALING FOR FABRICS BASED ON THE TACTILE SENSATION

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EVALUATION OF EMOTIONAL HEALING FOR FABRICS BASED ON THE TACTILE SENSATION

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ABSTRACT: "Iyashi" in the Japanese language, is used for goods, which people use to recover from the physical and psychological stress. If the healing emotion is observed when the consumer touches the fabric by hand, it is worthwhile to investigate the contribution of fabric property. This study approached both fundamental physical properties of fabrics and subjective evaluation to explore the contribution of fabric to emotional healing. Two sensory experiments were carried out. Participants (n=22) considered the fluffy fur as most likely to generate the healing emotion. "Healing feeling" was described as the combination in terms of "soft", "fluffy" and "smooth" perception for fabric samples. In the sensory evaluation of healing toys by hand, results of factor analysis, the first factor of "healing emotion" was the "surface factor", including "slippery", "smooth", "want to keep touching", "comfortable", "feel healing", and "soft". In terms of the physical properties of the fabric, the fabric with lower MMD (mean deviation of MIU) was preferable. The findings from this study can contribute to the evaluation and design of soft toys and clothing in satisfying the "healing emotion" of humans.

Key words: healing feel, tactile sensation, fabric, toy

KUMAŞLARIN DOKUNMA HİSSİNE DAYALI DUYGUSAL İYİLEŞME ETKİSİNİN DEĞERLENDİRİLMESİ

ÖZ: Japonca'da "Iyashi", insanların fiziksel ve psikolojik stresten kurtulmak için kullandıkları ürünler için kullanılmaktadır. Eğer tüketici kumaşa elle dokunduğunda iyileştirici duygu gözlemleniyorsa bu konu hakkında kumaş özelliklerinin katkısı araştırılmalıdır. Bu çalışmada kumaşın duygusal iyileşmeye katkısını keşfetmek için hem kumaşların temel fiziksel özellikleri incelenmiş, hem de öznel değerlendirme yapılmıştır. İki duyusal deney gerçekleştirilmiştir. Katılımcılar (n=22), tüylü kürklerin iyileştirici duyguyu oluşturma olasılığının yüksek olduğunu düşünmüşlerdir. Kumaş örneklerinde "iyileşme hissi"; "yumuşak", "kabarık" ve "pürüzsüz" algısının birleşimi olarak tanımlanmıştır. Elde tutulan oyuncakların duyusal değerlendirmesinde, faktör analizi sonucunda, "iyileştirici duygu"nun birinci faktörü "yüzey faktörü" olmak üzere "kaygan", "pürüzsüz", "dokunmaya devam etmek istiyorum", "rahat" "iyileşme hissediyorum" ve "yumuşak" ifadelerini içermektedir. Kumaşın fiziksel özellikleri açısından MMD'si (MIU'nun ortalama sapması) daha düşük olan kumaş tercih edilmiştir. Bu çalışmadan elde edilen bulgular, insanların "iyileştirme duygusunu" tatmin etmede yumuşak oyuncakların ve giysilerin değerlendirilmesine ve tasarlanmasına katkıda bulunmaktadır.

Anahtar Kelimeler: iyileşme hissi, dokunma hissi, kumaş, oyuncak

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1. INTRODUCTION

"Iyashi" in Japanese word is very popular word. "Iyashi" are used when people want to recover from the physical and psychological stress and used for human as well as goods [1]. The word "*heal"* means (1) to recover from an illness or injury, restore to health or soundness, and (2) to ease or relieve emotional distress [2]. "Iyashi" and "healing" is not exactly the same but in this study, "healing" is used according to the 2nd meaning and applied to various fabrics as well as toy goods made of fabric.

We wear clothing every day and fabrics are always surrounding around us. Everyone want to have peaceful time and fabric is one of the items to give us. If the healing emotion is observed when the consumer touches and handle the fabric by hand, it is worthwhile to investigate the contribution of fabric property to make useful design.

For the design of tactile texture to generate "healing or Iyashi", the process to decision making for perception must be understood. S.Okamoto et.al reported the process was largely composed of three layers of expressions: psychophysical, emotional, and preferential [3]. In this study, adjectives of physiological, emotional and preferential levels were used to evaluate two shapes of toys made from fabrics to find the association of those adjectives.

When fingers grasp toys or slide over toy fabrics, the sensation perceived by hand is considered to be the key parameters. Therefore, the influence of touch motion of human fingers is examined which might be associated with the emotionally heal feelings in human subjects. This study approached from both fundamental physical properties of fabrics and subjective evaluation to explore the contribution of fabric to the emotional healing.

2. MATERIAL AND METHOD

2.1. Samples

Thirteen fabric samples were chosen from three structures; fur, towel, woven and knitted structures to find the effect of surface structure and thickness. The sample specification of each fabric is shown in Table 1 [4]. The sample A, B, C were made of same material and structure but the pile length differs, D was made to imitate a poodle fur imitation with curve hairiness, E was velvet with a short cut pile. Towel samples such as F and G are similar grand yarn density but yarn twist angle differs. The sample H contained slit paper named Washi which make fabric harder. Plain fabric I and L were made of cotton and linen, respectively. Sample J was basket weave and K had woven by Jacquard, N was much thicker than other woven fabrics because of the waffle structure.

Table1. Sample specification

Sample	Material	Thickness (mm)	Weight (g/m²)	Density		Remark
				wale/ cm	course/ cm	
A	acrylic	2.7	264.0	7.4	10.4	Pile length P_L: 4mm
B	acrylic	5.2	323.8	7.4	10.4	P_L:7mm
C	acrylic	9.6	435.0	7.4	10.4	P_L:13mm
D	polyester	9.5	346.0	7.6	12.4	Poodle fur
				warp ends/cm	weft picks/cm	
E	polyester	1.5	288.3	27.5	33.5	Velvet
				warp ends/cm	weft picks/cm	
F	cotton	5.0	251.5	11.0	18.0	Towel
G	cotton	5.6	299.5	10.0	18.0	Towel
H	cotton/washi	7.6	488.0	13.0	29.0	Towel
				warp ends/cm	weft picks/cm	
I	cotton	0.48	77.1	39.2	36.0	Plain weave
J	triacetate (73) polyester (23)	0.64	159.0	6.4	8.2	Basket cloth
K	polyester	0.72	165.8	70.0	28.0	Jacquard
L	linen	0.74	255.3	17.8	14.0	Plain weave
N	cotton	3.02	218.8	24.4	24.6	Waffle cloth

2.2. Physical properties of samples

The fabric surface friction was measured using a surface tester (KES-SE-STP; Kato Tech. Co., Ltd. Japan). The mean coefficient of friction (MIU) and its deviation (MMD) were obtained for displacement intervals of 0.5 to 4.5 cm in wale/ warp and course/ weft directions. The fabric surface roughness was measured using a friction and roughness tester (KES-GU; Kato Tech. Co., Ltd., Japan). The average deviation of thickness (SMD) were calculated using the data between 5 and 25 mm in wale/ warp and course/ weft directions also. The fabric compression properties such as compression energy (WC), resilience (RC), linearity of compression-thickness curve (LC) and fabric thickness at 50Pa were measured using a compression tester (KES-G5) under the standard condition at five different area of a fabric [5]. q_{max}, indication of warm/ cool feeling was measured with the KES-F7 Thermolab αtester [6].

2.3. Subjective fabric evaluation

Participants. Twenty-two participants aged between 22 to 27 years old (14 female and 8 males of graduate students at Kyoto Institute of Technology) carried out two sensory experiments.

Experiment 1:

1. Participants were asked to touch 13 samples (20x20cm) freely and make rank from the strongest healing to the weakest. After they completed the ranking, they were asked to describe their "healing feeling" by words. The ranking results of healing were analysed by the normalized ranking method.
2. Participants were asked to slide three fingers on the fabric surface three times along warp direction (Y direction). Fabric was placed on the Tri-axial Force Plate (TF-2020-G, Tec Gihan Co., Ltd, Japan) to detect the vertical force (Fz in Figure 1). The coefficient of friction (μ) between the finger and the fabric was calculated using the equation in Figure 2.
3. Sensory evaluation using fourteen pairs of adjectives was carried out according to the semantic differential scale. Descriptive word pairs were as follows: warm/cool, smooth/rough, slippery/sticky, thin/thick, hairy/less hairy, bulky/sleazy, soft/hard, natural/artificial, comfortable/ uncomfortable, cheap/expensive, interesting/boring, new/get used to, want to keep touching/do not want to keep touching, feel healing/not feel healing. The ±3 points scale was used. The test was conducted in a room in which the temperature was 23±2°C and the relative humidity was 32.0±8%. Care was taken to ensure that the subjects' hands were not wet with sweat and clean.

Experiment 2

The ball and columnar shape toys were made from 13 fabrics as listed in Table 1. Fifteen grams of cotton wadding were filled in the ball toy and 10 grams for column toys as shown in Figure 3. Toys were placed in the black box and participants put their hands in the box (for right-handed participant: the ball on the right, the column on the left, left-handed participant is vice versa).

As shown in Figure 3, participant did the evaluation as follows;

(1) held the ball toy with the palm down followed by grasping it with five fingertips.

(2) held the column toy with both hands and twisted in the opposite direction.

After that, they evaluated tactile perception of these two toy samples using the same SD scale of 14 adjective pairs in Experiment 1.

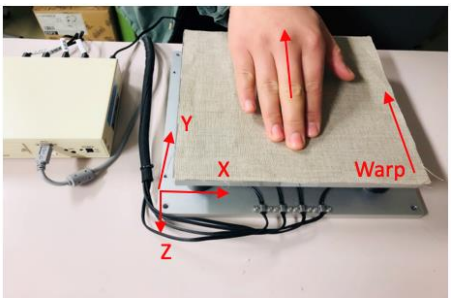

Figure1. Surface properties measured by finger movement

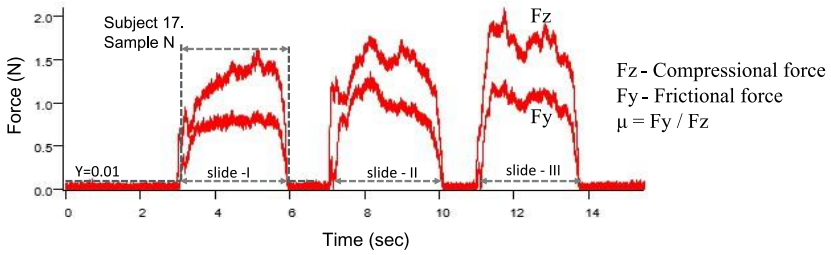

Figure 2. Changes of Finger force during three sliding on the sample N

Figure 3. Shape of toys and holding a ball toy

When two experiments were finished, participant chose the strongest healing sample (among toys and fabrics) and also the sample which they wanted to keep touching, and wrote the reason in the question sheets.

3. RESULTS AND DISCUSSION

3.1. Physical properties for fabrics

The physical properties were determined and its average values were listed in Table 2. Fur and towel samples show the higher mean coefficient of friction (MIU) compared to woven fabrics. Higher values of MIU could produce the higher interaction on the finger and may influence on tactile perception. Sample No. A, B, C are made of same acrylic fiber and structure but the pile length differs. The MIU values increased with the increase of pile length.

In the case of No. A, B and C, WC values increased with the increase of pile length. The WC value of waffle cloth (No. N) was almost the same value as fur No. A. The value is obviously higher than other woven fabrics because of its thickness due to the waffle structure. Compressional resilience (RC) of sample No. J showed highest value of 56.4% among samples, comparing to other fabrics.

Average heat flux (q_{max}) of fur and towel samples was between 0.024 and 0.083 W/cm^2. For sample woven fabrics, sample No. L (plain weave linen) was highest up to 0.1574 W/cm^2. Fabric with longer pile contains air showed lower heat flux.

In Figure 4, the average CoF (the coefficient of friction) measured during fingers move on the fabric surface was plotted against the MIU measured by the KES-SE friction tester. The high correlation (r=0.81) between the CoF and MIU were found.

The CoF difference among the 13 fabrics were significant (T-test, $p< 0.05$). The average values of CoF for sample No. B, C, D from the fur fabric group were significantly higher than those of the woven fabric group. Values of CoF obtained from No. C and D were also significantly higher than those values of towel No. F, G.

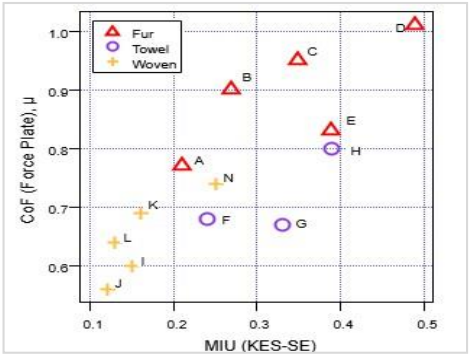

Figure 4. Relation between CoF and MIU

3.2. Sensory evaluation for "Healing" based on tactile sense for fabric (Experiment 1)

The normalized ranking values of "healing" and also, it's significant difference between samples are shown in Figure 5. Thirteen samples were grouped into 5 with significant difference. Fur fabrics of No. C, D and B were evaluated to generate the strongest "healing", they all had long piles. The next group included No. A and No. F, where No. A was also fur with 4mm pile length. The pile yarn of No. F had lowest twist angle among towel samples which generated the soft piles. Lowest evaluation of healing was No. H which surface was covered with looped piles containing paper material, so the surface was the hardest among towel samples. Therefore, fur fabrics with long pile was found to be effective to generate the strong healing.

Table2. Physical property of sample

Group	Sample	MIU		MMD		SMD (μm)		WC (J /m^2)	RC (%)	LC	q_{max} (W/cm^2)
		wale	course	wale	course	wale	course				
Fur fabric	A	0.21	0.30	0.0024	0.0055	2.99	4.70	1.93	51.5	0.46	0.055
	B	0.27	0.39	0.0025	0.0052	1.88	3.11	4.16	48.8	0.47	0.047
	C	0.35	0.46	0.0029	0.0043	1.37	1.79	7.95	49.8	0.45	0.040
	D	0.49	0.66	0.0033	0.0049	1.60	2.77	7.26	43.5	0.41	0.024
		warp	weft	warp	weft	warp	weft				
	E	0.39	0.39	0.0061	0.0073	12.36	8.89	0.23	35.5	0.44	0.083
		warp	weft	warp	weft	warp	weft				
Towel fabric	F	0.24	0.35	0.0084	0.0069	4.61	4.07	2.93	43.9	0.37	0.039
	G	0.33	0.33	0.0122	0.0109	5.22	5.80	3.01	37.6	0.37	0.038
	H	0.39	0.48	0.0259	0.0256	7.81	9.41	3.83	38.4	0.45	0.028
		warp	weft	warp	weft	warp	weft				
Woven fabric	I	0.15	0.39	0.0133	0.0145	1.97	2.02	0.21	42.8	0.28	0.142
	J	0.12	0.28	0.0054	0.0155	9.15	6.89	0.20	56.4	0.49	0.116
	K	0.16	0.16	0.0199	0.0178	6.09	5.68	0.24	41.1	0.47	0.112
	L	0.13	0.15	0.0248	0.0383	13.00	8.90	0.18	46.1	0.22	0.157
	N	0.25	0.28	0.0190	0.0242	6.74	8.05	1.94	41.4	0.48	0.042

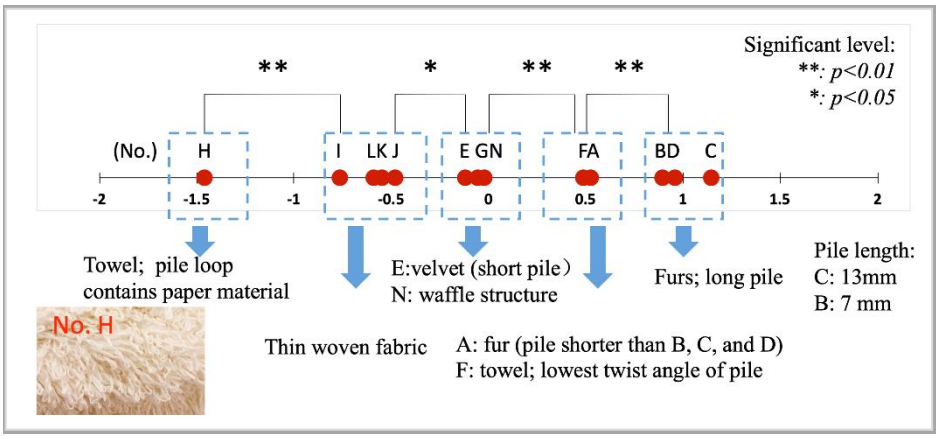

Figure 5. The normalized ranking of "Healing feel"

The description words related to "healing" was collected from participants. Five participants chose the keyword of "soft", such as "feel soft", "soft touch is important". Four participants considered "fluffy". Four participants defined "smooth", or "no roughness or graininess". The keyword "Warm", "Refreshing", "Comfortable" appeared twice respectively. In addition, "Healing" was also described by using following expressions; "nature", "low rebound", "the pile is fine", "the cloth is firm", "feels like stroking animals", "feel calm", "want to keep touching" and "make me relax". These words were the preliminary thoughts of participants who touched samples similar to products which have deep impression in their memory.

3.3. Sensory evaluation of healing toys by different finger manipulations (Experiment 2)

To find the change of sensation when a fabric was made into toy, sensory evaluation results of two experiments were analysed as listed in Table 3. In the adjective pair of "warm-cool", results of fabrics and toys were significantly different. Samples No. E and L felt cooler compared to the fabric sample. Both SMD values of No. L and No. E showed large values and heat flux (q_{max}) for L is relatively high (0.157). It showed that when fingers slid over the surface of the fabric, the roughness has a great influence on the warm sense.

For the following words "healing feeling", "want to keep touching", "comfortable", "soft", "bulky", thin fabric especially No. I and No. K were softer, bulkier and more comfortable. Participant also wanted to keep touching and felt more healed in "Experiment 2".

Because of the low WC values of thin fabrics and the low RC values of No. L and No. K, they were not considered as soft and good resilience as a fabric, however, making these into toys reduced this sense; and low MIU, SMD values of No. L and K showed that their surfaces were smooth, this can make them considered to have "feel healing" characteristics.

The "comfortable", "want to keep touching", "feel healing" of No. C had significantly declined after being made into toys, but toys made out of No. A and B were the same as those of fabrics. The fabric was no longer flat when it is made into a shape, so, the long pile of No. C would erect and bring people an uncomfortable experience.

Table 3. Significant difference between two samples as "Fabric" and "Toy"

Pairs of adjective		Sample												
		A	B	C	D	E	F	G	H	I	J	K	L	N
Warm	Cool					✓							✓	
Smooth	Rough											✓		
Thick	Thin			✓								✓		
Hairy	Less hairy													
Bulky	Sleazy									✓		✓		
Soft	Hard									✓		✓		
Slippery	Sticky							✓						
Interesting	Boring													
Comfortable	Uncomfortable			✓						✓		✓		
Nature	Artificial											✓		
Expensive	Cheap													
New	Get used to										✓			
Want to keep touch	Don't want to keep touching			✓						✓	✓	✓		
Feel healing	Not feel healing									✓		✓		

✓ Significant at the 0.05 level Significant at the 0.1 level

3.4. Overall evaluation of healing emotion

Participant chose the most healing sample (fabric and toy) when two experiments were finished. For the toys, most participants chose No. D with a rate of 44%, the reason was that it felt soft and fluffy, like touching animals. About 20% voted for No. C and B respectively. The hairiness No. C was considered to be very energetic, however, the hair length of No. B was considered to be suitable for touch. Comparing the result to Experiment 1, where No. C was evaluated "healing" because of "smooth", this evaluation showed that making fabrics into toys changed surface feeling of No. C.

The evaluation values of 22 subjects for 14 pairs of adjectives and 2 different tactile methods were used to perform the factor analysis. In sensory evaluation, factors affecting to the touch sensory from fabric and toys were listed in Table 4.

Table 4. Factor loading of sensory evaluation

Factor	Factor loading for Fabrics			Factor loading for Toys		
	Pairs of adjectives	Rotation Sums of Squared Loadings	Name of factor	Pairs of adjectives	Rotation Sums of Squared Loadings	Name of factor
1	slippery, smooth, want to keep touching, comfortable, feel healing, soft	7.00	Surface factor	slippery, smooth, soft, want to keep touching, comfortable, feel healing	5.66	Surface factor
2	thick, hairy, warm, bulky	6.66	Structural factor	hairy, thick, warm, bulky	4.26	Structural factor
3	new, interesting, expensive	2.79	Novelty factor	natural, interesting, feel healing, want to keep touching	4.27	Natural factor
4				new, interesting, expensive	2.41	Novelty factor

The first factor for fabric and toys were “surface factor” that include “slippery”, “smooth”, “want to keep touching”, “comfortable”, “feel healing”, and “soft”; the second factor was the “structural factor”, including the “thick”, “hairy”, “warm” and “bulky”. The factor “surface factor” including “slippery”, “smooth” etc. was greatly affected by pile directionality of fur, hard material (paper contained) in looped pile and woven fabric pattern.

Next, the “structural factor” which including “hairy”, “warm”, “bulky” etc. was largely determined by the pile length of fur, the twist angle of looped pile of towel, and the thickness of woven fabric. The third factor were different. For fabrics, it was the “novelty factor” that include the “new”, “interesting” and “expensive” which is similar to the fourth factor for toys. In case of toys, it was “natural factor” that include the “natural”, “interesting”, “feel healing”, and “want to keep touching”. The factor “novelty factor” was highly related to length of pile, and the curve of pile can weaken the alienation; the pattern of fabric also caused the alienation.

In Figure 6, the average “Healing” score of toy evaluation (Experiment 2) are plotted against that of fabric score. Linear relationship was observed with R^2=087.

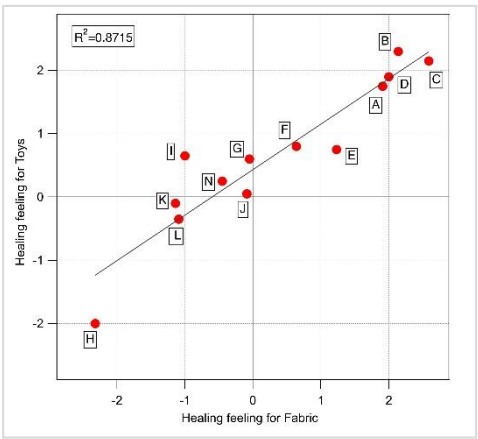

Figure 6. Relation between fabric and toy related to Healing feeling

4. CONCLUSIONS

“Healing (Isyashi)” emotion was evaluated by the sensory evaluation of sample fabrics and toys. Results of sensory evaluation using the ranking method of fabrics “healing”, fur fabrics were chosen to generate the strongest “healing feeling”, especially the fluffy ones with long piles. “Healing feeling” was considered as the combination of “soft”, “fluffy” and “smooth” perceptions. In the case of using healing toys made of same fabrics, the strongest factor of “healing emotion” was found to be “surface factor”, including “slippery”, “smooth”, “want to keep touching”, “comfortable”, and “soft”. High correlation coefficient between the fabric healing feeling and the toy was observed. The findings from this study can contribute to show the evaluation methodology and the design for soft toys, and maybe future clothing.

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