Analysis of Impression from Geometric Patterns in Textiles of Cultural Properties in Japan

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Abstract. The cultural properties preserved in Shoso-in (the treasure house) and Horyuji (Horyu-Temple) in Nara Prefecture from the 7th century to the 8th century is extremely meaningful in history of Japan. In Shoso-in and Horyuji, quite a lot of articles left by the departed at this age exist. It is important to observe the sensibilities at that time. In this paper, we paid attention to the patterns of beaded medallions, which are one of geometric patterns, in the textiles of the cultural properties. The patterns are composed of the outer circle, the inner circle and the beaded medallions. Analysis of impression from the circle patterns was carried out. For many persons, the favorite circle patterns are such patterns that the beaded medallions are contacted between the outer circle and the inner circle. The patterns of the beaded medallions in textiles of cultural properties were accepted enough to modern people.

1. Introduction

In Japan, the cultural properties of the Nara period contain the flow of the two kinds of the cultures. One is the flowering of the Tang Dynasty style art by the flow of a Chinese culture. The other is the sprout of the national customs and manners culture after the 9th century. Nara is called the terminal of the Silk Road. In Shoso-in and Horyuji, quite a lot of articles left by the departed at this age exist. It is important to observe the sensibilities at that time. In this paper, we paid attention to the several kinds of the circle patterns in the textiles of the cultural properties. The patterns are composed of the outer circle, the inner circle and the beaded medallions. The representative textiles from the 7th century to the 8th century are Nishiki and Aya. The circle patterns were drawn on the textiles. In this study, we investigated the relationship between the geometric features in patterns of beaded medallions and weaving techniques of textiles. Information of geometric properties was extracted by using the computer program developed in our research. The objective patterns of the circles were approximated as the ovals. The program measured the longitudinal
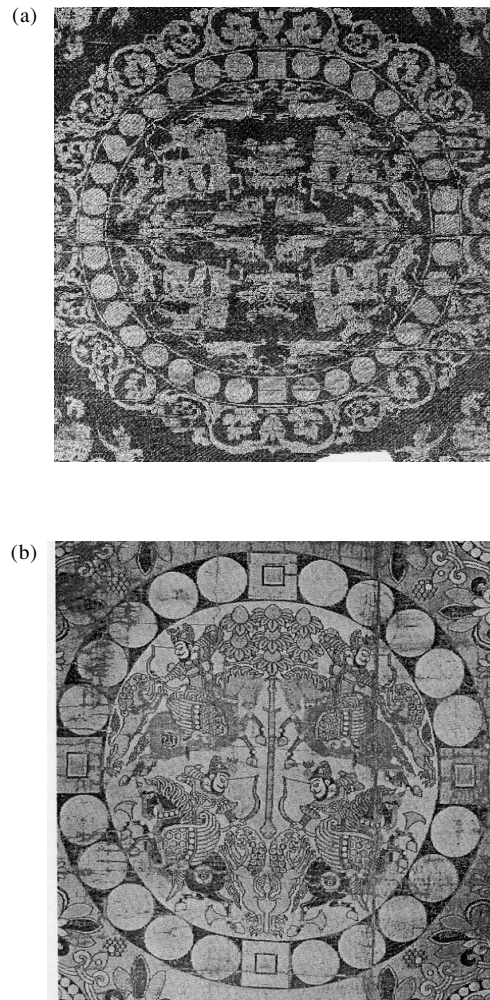
Fig. 1. The textiles of the cultural properties. (a) Nishiki with beaded medallions enclosing hunting scene
patterns on a green ground. (b) Nishiki with patterns of beaded medallions enclosing four mounted lion
hunters. (c) Boar's head in roundel with pearl design border in brocade.

radius and transverse radius in the ovals. The ratio of longitudinal and transverse radius
(longitudinal/transverse) was calculated. Then the ratio of transverse radius on outer circle,
inner circle, and beaded medallion were calculated. Geometric properties of patterns of
beaded medallions were supposed to depend on the weaving techniques. We made the
circle patterns based on these patterns in textiles and varied the ratio of transverse radius
among outer circle, inner circle and beaded medallion. The impression of the circle patterns
drawn by the ancient people was noticed. Analysis of impression from the circle patterns
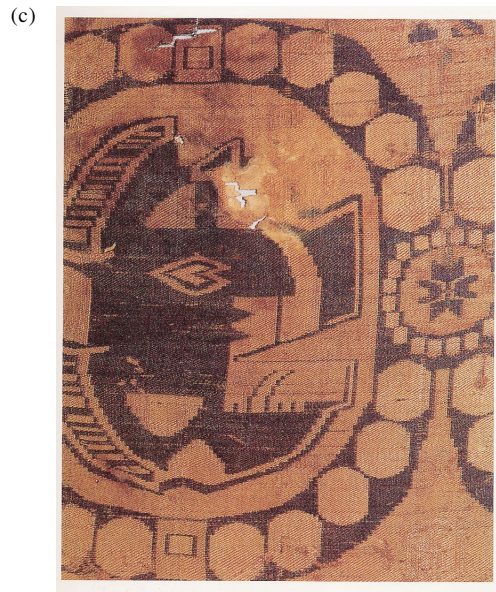was carried out.

(c)

Fig. 1. (continued).

2. Evaluation Procedure of Impression

2.1. Circle patterns

Examples of textiles with the patterns of beaded medallions are shown in Fig. 1 (MATSUMOTO, 1984; ZHAO, 1999). The names of the textile are (a) Nishiki with beaded medallions enclosing hunting scene patterns on a green ground, (b) Nishiki with patterns of beaded medallions enclosing four mounted lion hunters, (c) Boar's head in roundel with pearl design border in brocade. The ratio of transverse radius on outer circle, inner circle, and beaded medallion were (a) 1:0.85:0.066, (b) 1:0.75:0.11, (c) 1:0.69:0.098. We made the circle patterns based on these patterns of beaded medallions. The circle patterns were varied the ratio of transverse radius among outer circle, inner circle and beaded medallion. Radius of outer circle was maintained, and radius of inner circle was varied in sequence. Beaded medallions were sustained the center of the space between outer circle and inner circle. The number of beaded medallions in each circle was fixed 20. Beaded medallions were contacted each other if possible. The size of beaded medallions in each circle pattern was determined naturally. The ten kinds of the circle patterns were employed. The circle patterns are shown in Fig. 2. Beaded medallions are contacted each other in pattern D-1 to D-7. Beaded medallions were separated each other in pattern D-8 to D-10. And the ratio of transverse radius among outer circle, inner circle and beaded medallion of these circle patterns are shown in Table 1. These circle patterns are called singular circle patterns. And repeated circle patterns were made to evaluate another sight. Two types of repeated patterns
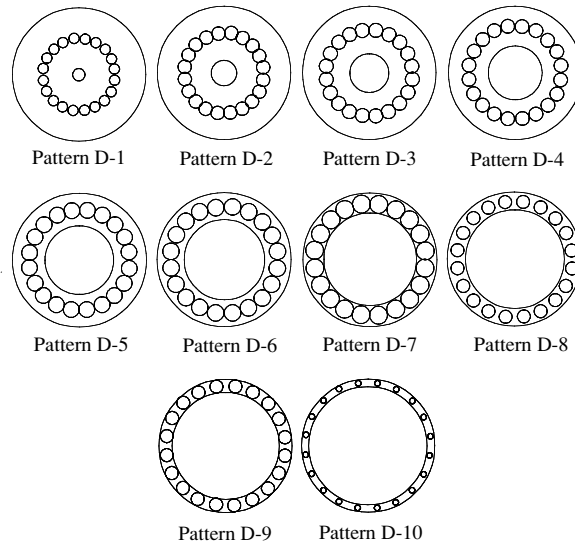
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Fig. 2. The singular circle patterns.

Table 1. The ratio of transverse radius among outer circle, inner circle and beaded medallion of the singular circle patterns.

	Outer circle	:	Inner circle	:	Beaded medallion
Pattern D-1	1	:	0.10	:	0.084
Pattern D-2	1	:	0.20	:	0.092
Pattern D-3	1	:	0.30	:	0.101
Pattern D-4	1	:	0.40	:	0.106
Pattern D-5	1	:	0.50	:	0.116
Pattern D-6	1	:	0.60	:	0.126
Pattern D-7	1	:	0.70	:	0.131
Pattern D-8	1	:	0.75	:	0.096
Pattern D-9	1	:	0.80	:	0.097
Pattern D-10	1	:	0.90	:	0.049

were made. Figure 3 shows the patterns. Circle patterns that adjoin with four points and six points around the circles were employed. The former was called Type s and the latter was called Type t.

2.2. Evaluation of the patterns

The impression of the circle patterns drawn by the ancient people was noticed. Analysis of impression from the circle patterns was carried out. In the case of singular circle

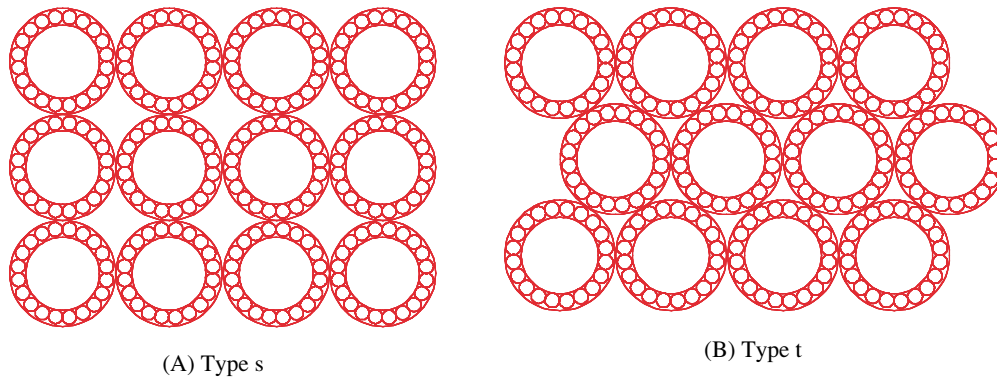(A) Type s   (B) Type t

Fig. 3. The repeated circle patterns.

pattern, we arranged papers so that one kind of circle pattern was drawn on the center of the paper. The size of paper is A5. In the case of repeated circle pattern, we arranged papers so that one kind of circle pattern was drawn on almost allover the paper. The size of paper is A4. The subjects were given no information about the ratio of the circle patterns beforehand. The subjects evaluated their first impressions of the circle patterns and replied the order of the favorite patterns. In addition, the subjects replied the imaged matters about the most favorite pattern. The subjects were students of faculty of engineering, and their family and their friends. In the case of singular circle pattern, the number of subjects was 59. In the number of subjects, men were 33 people, and women were 26 people. In the age, 28 people were from 15 to 22 years old, and 31 people were from 23 to 52 years old. In the case of repeated circle pattern, the number of subjects was 29. In the number of subjects, men were 23 people, and women were 6 people. In the age, all people were from 17 to 50 years old.

3. Results and Discussions

    The results of analysis of impression are shown in Figs. 4, 5 and 6. The transverse axis shows the pattern number, and the longitudinal axis shows the frequency. In the results of favorite pattern, the "First" of the category shows the number of the subjects, who evaluated the object pattern as the most favorite. The "Second" and the "Third" of the category show the numbers of the subjects, who evaluated the object patterns as secondary and tertiary favorite respectively. In the results of hate pattern, the "First" of the category shows the number of the subjects, who evaluated the object pattern as the most hate. The "Second" and the "Third" of the category show the numbers of the subjects, who evaluated the object patterns as secondary and tertiary hate respectively. These results show the sum of the "First", "Second" and "Third" on each pattern. The decision of the most favorite (or hate) pattern is as follows:
    1)   The first favorite (or hate) pattern for the most subjects.
    2)   The first favorite (or hate) pattern for the secondary many subjects.
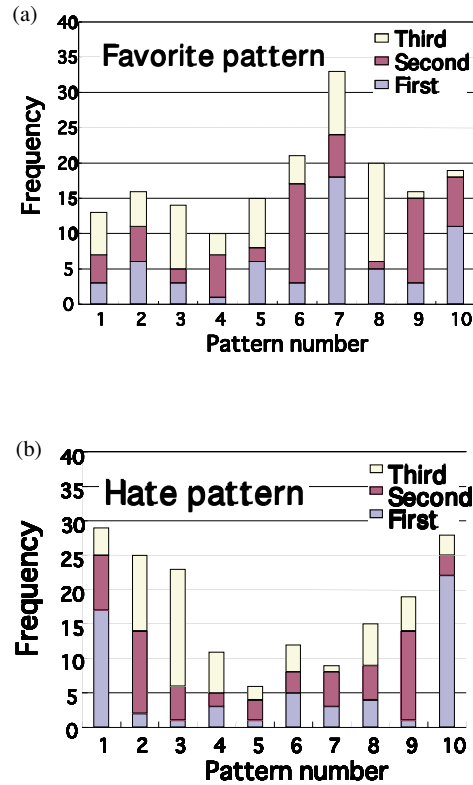
(a)

(b)

Fig. 4. Results of impression from singular circle patterns. (a) The favorite circle patterns. (b) The hate circle patterns.

3)   The secondary favorite (or hate) pattern for the most subjects.

4)   The pattern that the sum of the first, secondary and tertiary favorite (or hate) of that is largest.

The priority of these numbers is as this order, and in the case of the pattern that both favorite and hate for the subjects, the results of many subjects are prior.

In the case of singular circle pattern, the most favorite pattern for the most subjects is pattern D-7. The most favorite pattern for the secondary many subjects is D-10. The secondary favorite pattern for the most subjects is D-6. The sum of the most, secondary and tertiary favorite pattern on D-7 is the largest, and the sum on D-6 is secondary. The most hate pattern for the most subjects is D-10. The most hate pattern for the secondary many subjects is D-1. The secondary hate pattern for the most subjects is D-9. The sum of the most, secondary and tertiary hate pattern on D-1 is the largest, and the sum on D-10 is secondary. Considering these results, the favorite patterns for many persons are pattern D-7 and D-6, and the hate patterns for many persons are D-10 and D-1.

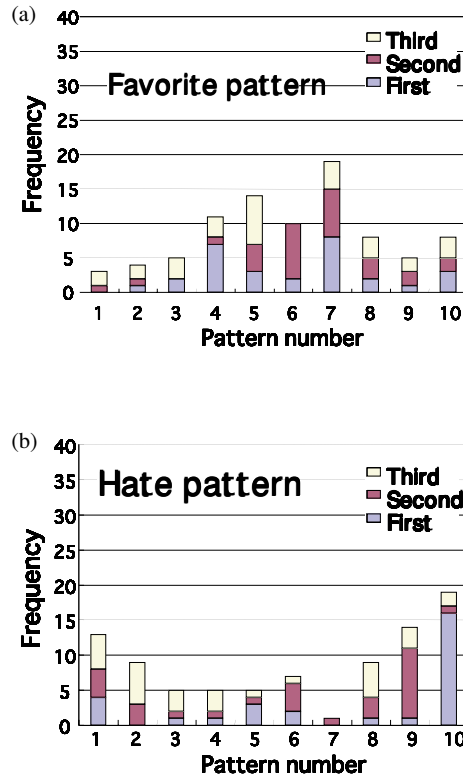In the case of repeated circle pattern Type s, the most favorite pattern for the most

Fig. 5. Results of impression from repeated circle patterns (Type s). (a) The favorite circle patterns. (b) The hate circle patterns.

subjects is D-7. The most favorite pattern for the secondary many subjects is D-4. The secondary favorite pattern for the most subjects is D-6. The sum of the most, secondary and tertiary favorite pattern on D-7 is the largest, and the sum on D-5 is secondary. The most hate pattern for the most subjects is D-10. The most hate pattern for the secondary many subjects is D-1. The secondary hate pattern for the most subjects is pattern D-9. The sum of the most, secondary and tertiary hate pattern on D-10 is the largest, and the sum on D-1 is secondary. Considering these results, the favorite patterns for many persons are pattern D-7, D-4 and D-5, and the hate patterns for many persons are D-10, D-9 and D-1.

In the case of repeated circle pattern Type t, the most favorite pattern for the most subjects is D-7. The most favorite pattern for the secondary many subjects is D-6. The secondary favorite pattern for the most subjects is D-9. The sum of the most, secondary and tertiary favorite pattern on D-7 is the largest, and the sum on D-6 is secondary. The most hate pattern for the most subjects is D-10. The most hate pattern for the secondary many subjects is D-1. The secondary hate pattern for the most subjects is D-9. The sum of the most, secondary and tertiary hate pattern on D-9 is the largest, and the sum on D-10 is
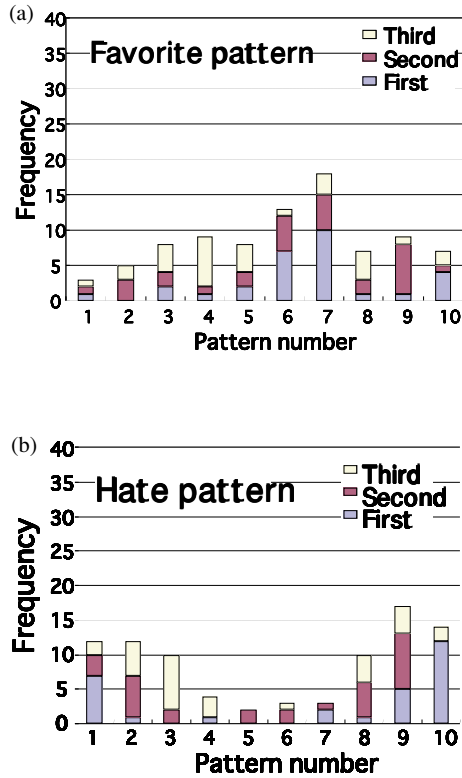
(a)

(b)

Fig. 6. Results of impression from repeated circle patterns (Type t). (a) The favorite circle patterns. (b) The hate circle patterns.

secondary. Considering these results, the favorite patterns for many persons are D-7 and D-6, and the hate patterns for many persons are D-10, D-1 and D-9.

The imaged matters about the most favorite pattern were, for example, sunflower, ball bearing, and dish. For many persons, the favorite circle patterns are such patterns that the beaded medallions are contacted between the outer circle and the inner circle. It is considered that the favorite circle patterns are near the shape which they have experience to see and reasonable shape structurally. The hate patterns are such patterns that the beaded medallions are extremely small or beaded medallions don't adjoin to outer circle and inner circle. It is considered that the patterns are the shape that they have no experience to see and unstable shape structurally. The favorite patterns for many persons are pattern D-7 and D-6. The ratio of transverse radius among outer circle, inner circle and beaded medallion of D-7 is 1:0.70:0.131, and the ratio of D-6 is 1:0.60:0.126. The ratio of favorite circle patterns were very closed the ratio of patterns of the beaded medallions in textiles of cultural properties. Beaded medallions of D-7 are the closest to outer circle and inner circle. It is considered that the results of D-7 are influenced by this condition. The ratio of D-8 is

also closed the ratio of patterns of the beaded medallions, but D-8 is not the favorite pattern for many persons. The beaded medallions of D-8 are separated each other. On the other hand, the beaded medallions of D-7 and D-6 are contacted each other. It is considered that the results of D-8 are influenced by the arrangement of the beaded medallions. Therefore, the patterns of the beaded medallions in textiles of cultural properties were accepted enough to modern people. In the case of Type s, repeated circle patterns are apt to evaluated by looking each circle pattern. In the case of Type t, repeated circle patterns are apt to evaluated by looking a whole pattern. It is considered that this aptness functions the relevance between the ratio of each circle pattern and the scale of the space that exist among circle patterns. It is shown that the favorite repeated circle patterns are the repeated favorite singular circle pattern.

4. Conclusions

It is considered that the favorite singular circle patterns are near the shape which they have experience to see and reasonable shape structurally. It is shown that the favorite repeated circle patterns are the repeated favorite singular circle pattern. The ratios of transverse radius among outer circle, inner circle and beaded medallion of favorite circle patterns were very closed the ratios of patterns of the beaded medallions in textiles of cultural properties. These ratios are 1:0.70:0.131 and 1:0.60:0.126. The patterns of the beaded medallions in textiles of cultural properties were accepted enough to modern people.

REFERENCES

Matsumoto, K. (1984) *Jodai-Gire*, Shikosha, Kyoto, Japan, 57 pp.
Zhao, F. (1999) *Treasures in Silk*, ISAT/Costume Squad Ltd., Hong Kong, 111 pp.