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A Study on the Impression of Package Designs Featuring Woodgrain Printing

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Abstract: This study sought to examine the impression of product package designs featuring woodgrain printing through experiments and to find out impression differences they give depending on their patterns and printing methods. In particular, it focused on the “authentic” impression of the woodgrain patterns. The experiment used 15 samples with different combination of sheets with various woodgrain patterns or printing methods, shapes (box package), different pattern directions, etc. 100 male and female participants aging from 20s to 70s evaluated their impressions from the viewpoint of three evaluation items, “high-class”, “beautiful”, and “authentic”, through paired comparison tests. The test results were then put to the analytic hierarchy process and interval analytic hierarchy process. The analyses clarified the following features:
1.The woodgrain patterns printed with the new printing method obtained high score in the “authentic” and overall evaluations;
2.Different age groups and genders demonstrated different evaluation tendencies in assessing the “beautiful” and “high-class” features;
3.No significant difference was observed between the evaluations for sheets and boxes;
4.As for the printing method for the box side, participants found it more authentic-looking when the pattern on the top seamlessly continues to the side.
5.The “high-class” evaluation item was found to be prioritized above the “beauty” and “authenticity”.

Keywords: Package Design, Woodgrain, Impression, authenticity

1. PURPOSE OF RESEARCH

This study sought to examine the impression of product package designs featuring woodgrain printing through experiments and to find out impression differences they give depending on their patterns and printing methods. In particular, it focused on the “authentic” impression of the woodgrain patterns.

2. LITERATURE

The study cases in recent years about package design may be classified into two types, the studies based on viewpoint of company or the studies based on viewpoint of consumer. The group of the viewpoint of company includes the studies examine what kinds of package design are effective in the position of branding or market strategy, etc. Cases of this kind in recent years are the study by Lin et al. and the study by Chou et al. Lin examined worth of the hood packages from the position of branding strategy. Moreover, Chou studied the features in the package designs of the beverage market in Taiwan. The purpose of the research based on viewpoint of consumer is to clarify the factors of the evaluation of consumers to package design, therefore the researches which investigate the impression or remarkable point of consumers are included in this group. Cases of this kind in recent years are the study by So et al. and the study by Hashida et al. In study by So, the elements of the package design which consumers are observing were clarified by measurement of eye movement using eye-tracker. Moreover, in study by Hashida, consumers' visual attention was studied using the method of saliency map.

This research is classified into the type of the studies based on viewpoint of consumer. The results of impression evaluation experiment were analyzed by the analytical methods. Analytical method is not a new method. However, the method of this research is effective and reliable as a quantitative approach of investigating consumers' sense of values which cannot be clarified by measurement of eye movement.

3. EXPERIMENT

3.1. Outline

Various woodgrain sheets which differ in the kind of grain or a printing method, what made them for the boxes and the boxes into which the pattern direction was changed, are prepared. Participants evaluate their impressions from the viewpoint of three evaluation items, “high-class”, “beautiful”, and “authentic”, through paired comparison tests. In totaling the evaluation results and analyzing by a multivariate analysis, it is investigated how the subject's impression changes with differences in the pattern or the printing method.

3.2. Impression Evaluation

3.2.1. Experiment Method

The experiment is divided into six steps, and is conducted and from 1 to 6 is continuously performed in one experiment about one subject. The method of evaluation is paired comparison tests between samples.

In Step 1, four kinds of the printing sheets of Japan cedar in which the design of grain and the printing method differ from each other are compared and evaluated. Arranging every two sheets of those on a table, a participant compares the samples and enters an evaluation result in an

evaluation paper. The entry method of evaluation is the way of checking either of nine steps of rate scales. Evaluation time is not restricted. After filling finishes, the combination of the samples is changed, evaluation is repeated, and all the combinations are evaluated. Evaluation criteria are three items of “high-class”, “beautiful”, and “authentic”.

Step 2 is the same procedure as Step 1, and is performed for the sheets of the pattern of three kinds of paulownia.

In Step 3, three of four kinds of samples used at Step 1 are made for three boxes, and those samples are evaluated. This evaluation is performed in order to check whether evaluation results differ in the case of sheets, and in the case of three-dimensional objects. Methods of operation are the same as that of Step 1 and Step 2.

Step 4 is the same purpose as Step 3, and it is performed to the samples of paulownia grain used at Step 2. Methods of operation are the same as that of Step 3.

Step 5 targets two kinds of woodgrain patterns, sample 1-A (Japan cedar by the new printing method) of Step 1, and sample 2-A (paulownia by the new printing method) of Step 2. The samples are made for boxes, the samples which the pattern of the side printed in the direction follows the pattern on top are compared with the samples which does not follow a pattern on top, and “authentic” is evaluated. This evaluation is performed in order to investigate which print direction and which woodgrain is felt with more “authentic”.

In Step 6, three evaluation criteria of Step 1 are compared about which item is thought as important at the time of purchase. Since this step is only evaluation between items, the samples do not use.

3.2.2. Evaluation Samples

The experiment used 15 samples with different combination of sheets with various woodgrain patterns or printing methods, shapes (box package), different pattern directions, etc. The sample A of Step 1 and Step 3 is the woodgrain of Japan cedar by new print method. The sample A of Step 2 and Step 4 is the woodgrain of paulownia printed in the similar way. Although the usual grain printing is printed by 4 colors, the original new printing method is the method of printing by 7 colors. As the other sample, three kinds of grain of Japan cedar by the general printing method for Step 1 were chosen. Moreover, for Step 3, two kinds of samples were chosen from the three. Since the purpose of Step 3 was to check the difference with the result of Step 1, the number of samples was reduced. Similarly, two kinds of grain of paulownia by the general printing method for Step 2 and Step 4 were chosen. At Step 5, the box samples of Japan cedar and paulownia by the new printing method used at Step 4 were used, and the samples by which the print direction of the side was changed were also prepared. As for the samples of Step 5, height was made higher than the samples of Step 4 so that it might be easier for the participants to understand the difference in the side of the box. The size of each sample group is the following.

Sheet: 275 W x 170 H (mm)

Box (Step 4): 225 W x 270 D x 30 H (mm)

Box (Step 5): 225 W x 270 D x 70 H (mm)

The samples are shown in Figs. 1 - Figs.5.

Figure 1: Samples for Step 1 (1-A, 1-B, 1-C, 1-D from the left)

Figure 2: Samples for Step 2 (2-A, 2-B, 2-C from the left)

Figure 3: Samples for Step 3 (3-A, 3-B, 3-C from the left)

Figure 4: Samples for Step 4 (4-A, 4-B, 4-C from the left)

Figure 5: Samples for Step 5 (5-A, 5-B, 5-C, 5-D from the left)

3.2.3. Evaluation Items

The impression of “authentic” is the first of evaluation item. Furthermore, the “high-class” and the “beautiful” which are considered to Samples for Step 3 (3-A, 3-B, 3-C from the left)be thought as important by the package design of grain were added to evaluation criteria. By evaluating these three items, respectively, the difference in the evaluation results of the samples for every item Moreover, in Step 6, it is shown clearly which item is more important for the participants by comparison of evaluation items.

3.2.4. Participant

The participants are 100 male and female aging from 20s to 70s who are considered to be the buyers of goods in which the woodgrain package is used. It was considered that each age was distributed as much as possible equally. The participants were classified into five groups of 20s, 30s, 40s, 50s, and over-60. The number of each group was made into about 20 persons.

4. EXPERIMENTAL RESULTS

100 male and female participants aging from 20s to 70s evaluated their impressions from the viewpoint of three evaluation items, “high-class”, “beautiful”, and “authentic”, through paired comparison tests. The numbers of each participant group were 22 in 20s, 19 in 30s, 21 in 40s, 18 in 50s, and 20 in over-60. 44 of 100 participants were males. The evaluation results obtained by paired comparison tests were converted into nine steps numerical values, and all were totaled.

5. ANALYSIS

5.1. Analytic Hierarchy Process (AHP)

In this research, the analytic hierarchy process (AHP) is used as the analysis method. It was developed by Thomas L. Saaty at the University of Pittsburgh in the 1970s and has been refined since then. AHP is a structured technique for organizing and analyzing complex decisions, and is one of the methods which changes subjective judgment of human into numerical values. Moreover, in order to verify the validity of the analysis result by the AHP, the interval analytic hierarchy process method is used.

The interval AHP is a kind of the section analysis which receives attention in recent years, and is the expansive method of the AHP. The interval AHP is a nonlinear analysis and it is the method of reflecting the inconsistency (non-transitivity) between evaluation values on a result. In addition, analysis was conducted by having divided into each age group, males, and females other than all the participants, and checked the difference arising from the participant's attribute.

5.2. Analysis Results

5.2.1. Analysis Results of Steps 1- 4

The test results were put to the analytic hierarchy process and interval analytic hierarchy process.

The analysis result of Step 1 by AHP was as follows (Table 1). In the analysis result of “authentic” to the grain of Japan cedar, the sample 1-A by new print method obtained high score. In the analysis result of a "high-class", the sample 1-D was the 1st place, the sample 1-A was the 2nd place, and the sample 1-C was the 3rd place. Those numerical values were near. In a "beautiful" analysis result, although the 1st place was the sample 1-B, the 2nd place was the sample 1-D and the 3rd place was the sample 1-A, there was almost no difference. In the comprehensive evaluation which united evaluation of three items, the sample 1-A was the 1st place and the sample 1-D was the 2nd. Since both consistency index (C.I.) value and consistency ratio (C.R.) value were low enough in the analysis result, it was judged that the analysis result of Step 1 was significant.

The analysis result of Step 2 is shown in Table 2. In the analysis result of “authentic” to the grain of paulownia, the sample 2-C was the 1st place and the sample 2-A by the new print method was the 2nd. In the item of the "high-class ", the sample 2-C was the 1st place and the sample 2-A was the 2nd. At the analysis result of " beautiful ", the sample 2-A was the 1st place in the very high score. In comprehensive evaluation, sample 2-A was the 1st place, and sample 2-C was the 2nd. Since both C.I. value and C.R. value were low enough in the analysis result, it was judged that the analysis result of Step 2 was significant. In addition, since the result of Step 6 is used for the analysis between evaluation items in common, the degrees of priorities between items are the same as the values of Step 1.

The analysis result of Step 3 is shown in Table 3. According to the item of "authentic" and "high-class", sample 3-A showed the high score clearly compared with other samples. In the item of "beautiful", sample 3-B was the 1st place, and sample 3-A was the 2nd. Also comprehensive evaluation, sample 3-A was the 1st place in the very high score. Since both C.I. value and C.R. value were low enough in the analysis result, it was judged that the analysis result of Step 3 was significant.

The analysis result of Step 4 is shown in Table 4. Sample 4-A shows the very high score compared with other samples according to all the items “authentic”, "high-class", and "beautiful". Also comprehensive evaluation, sample 4-A was the 1st place in the very high score. Since both C.I. value and C.R. value were low enough in the analysis result, it was judged that the analysis result of Step 4 was significant.

Table 1: Analysis Result of Step 1

Item	authentic	high-class	beautiful	comprehensive
Priority	0.188	0.498	0.314	evaluation value
1- A	0.473	0.283	0.277	0.317
1- B	0.090	0.145	0.293	0.181
1- C	0.195	0.222	0.152	0.195
1- D	0.241	0.351	0.278	0.307

Item	authentic	high-class	beautiful	Priority
Lamda	4.016	4.009	4.007	3.019
C. I.	0.005	0.003	0.002	0.009
C. R.	0.006	0.003	0.003	0.016

Table 2: Analysis Result of Step 2

Item	authentic	high-class	beautiful	comprehensive
Priority	0.188	0.498	0.314	evaluation value
2 - A	0.353	0.328	0.591	0.415
2 - B	0.184	0.308	0.247	0.266
2 - C	0.462	0.364	0.163	0.319

Item	authentic	high-class	beautiful	Priority
Lamda	3.037	3.001	3.000	3.019
C. I.	0.019	0.001	0.000	0.009
C. R.	0.032	0.001	0.000	0.016

Table 3: Analysis Result of Step 3

Item	authentic	high-class	beautiful	comprehensive
Priority	0.188	0.498	0.314	evaluation value
3 - A	0.519	0.422	0.382	0.428
3 - B	0.170	0.230	0.407	0.274
3 - C	0.311	0.348	0.211	0.298

Item	authentic	high-class	beautiful	Priority
Lamda	3.040	3.018	3.000	3.019
C. I.	0.020	0.009	0.000	0.009
C. R.	0.034	0.015	0.000	0.016

Table 4: Analysis Result of Step 4

Item	authentic	high-class	beautiful	comprehensive
Priority	0.188	0.498	0.314	evaluation value
4 - A	0.528	0.453	0.562	0.502
4 - B	0.179	0.267	0.254	0.246
4 - C	0.293	0.280	0.184	0.252

Item	authentic	high-class	beautiful	Priority
Lamda	3.041	3.024	3.061	3.019
C. I.	0.020	0.012	0.030	0.009
C. R.	0.035	0.021	0.052	0.016

5.2.2. Analysis Result of Step 5

Only the item of " authentic " was evaluated in Step 5. The result is shown in Table 5. According to the degree of priorities of this analysis result, the sample 5-A was felt the most authentic by the participants. It is the sample of the grain of Japan cedar which the pattern on the top seamlessly continues to the side. The 2nd place was the sample of Japan cedar which the pattern of the side and the pattern on the top does not continues to the side. The 3rd place was the sample of paulownia which the pattern on the top continues to the side, and the lowest was the sample of paulownia which the pattern does not continues. From these results, the Japan cedar is felt " authentic " rather than paulownia, moreover, about the print direction, the printing method which the pattern on the top seamlessly continues to the side is felt " authentic ". Since both C.I. value and C.R. value were low enough in the analysis result, it was judged that the analysis result of Step 5 was significant.

Table 5: Analysis Result of Step 5

authentic	5 - A	5 - B	5 - C	5 - D	Priority
5 - A	1	1.460	2.273	1.469	0.359
5 - B		1	1.474	1.473	0.262
5 - C			1	1.541	0.200
5 - D				1	0.180

Lamda	4.069
C. I.	0.023
C. R.	0.026

5.2.3. Analysis Result of Step 6

The item judged to be the most important for the participants with the priorities of three evaluation items "authentic", "high-class ", and " beautiful ", was "high-class" (Table 6). This result was common irrespective of age groups or genders. It became clear that the "high-class" is thought most as important to the package using woodgrain.

Table 6: Analysis Result of Step 6

Item	authentic	high-class	beautiful
Priority	0.188	0.498	0.314

5.2.4. Analysis Result by Interval AHP

Interval AHP was conducted using the same data analyzed by AHP. By the interval AHP method, since the result of having unified the result of each item was not computed, it was analyzed for every item. Some graphs of the analysis results are shown in Fig. 6 - Fig. 9. At these results, in the item of the "beautiful" of Step 1, part of sections of the 1st place, the 2nd place, and the 3rd place overlapped. The relation of the 2nd place and the 3rd place of the item of the "beautiful" of Step 4, the 2nd place and the 3rd place of the item of the "high-class" of Step 4, and the 2nd place to the 4th place of Step 5 are also the same. For this reason, it cannot be judged that a clear difference is among these samples. However, it was checked that the samples of the 1st place have clear predominancy to the samples below the 2nd place except for the item of the "beauty" of Step 1.

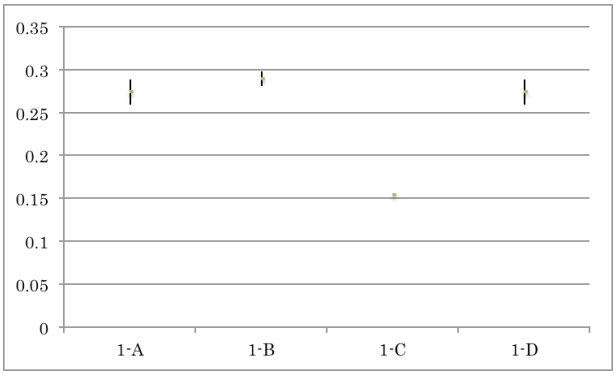

Figure 6: Result of Step 1 ”beautiful”

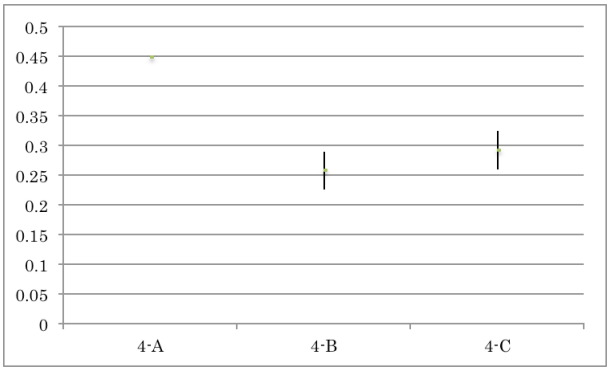

Figure 7: Result of Step 4 “high-class”

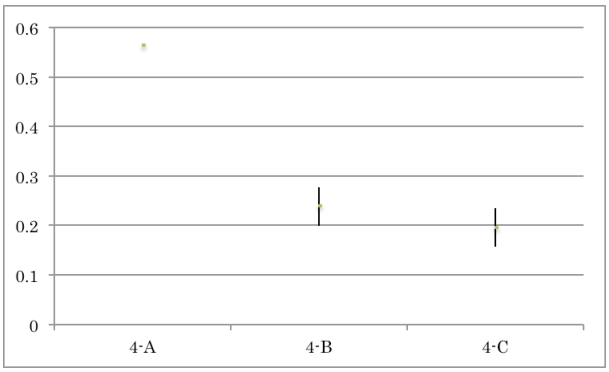

Figure 8: Result of Step 4 “beautiful”

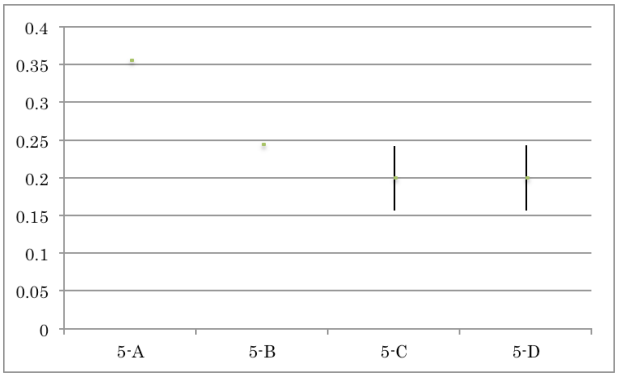

Figure 9: Result of Step 5 “authentic”

6. DISCUSSION

6.1. Overall Tendency of Analysis Results

With the comprehensive evaluation values of the analysis results for the full participant of Step 1 to the Step 4, the ranking of the samples was shown in Table 8. Moreover, the ranking for every evaluation items are shown in Table 7 – Table 10. At the result of the item of the "beautiful" of Step 1, there was almost no difference in the values of top three samples, virtually there are no superiority or inferiority. In the comprehensive evaluation values of the other analysis results, the sample A was the 1st place at every step. They were all the samples by original new print method.

Table 7: Ranking of each step (comprehensive evaluation)

Comprehensive evaluation	Step1	Step 2	Step 3	Step 4
1st	A (0.317)	A (0.415)	A (0.428)	A (0.502)
2nd	D (0.307)	C (0.319)	C (0.298)	C (0.252)
3rd	C (0.195)	B (0.266)	B (0.274)	B (0.246)
4th	B (0.181)			

Table 8: Ranking of each step (authentic)

Authentic	Step1	Step 2	Step 3	Step 4
1st	A (0.473)	C (0.462)	A (0.519)	A (0.528)
2nd	D (0.241)	A (0.353)	C (0.311)	C (0.293)
3rd	C (0.195)	B (0.184)	B (0.170)	B (0.179)
4th	B (0.090)			

In the results of the item of "authentic" of Steps 1, 3, and 4, the sample A ranked 1st like comprehensive evaluation. However, sample 2-C ranked 1st at Step 2. In the item of "high-class", it differs from comprehensive evaluation in that the 1st place of Step 1 is sample 1-B and the 1st place of Step 2 is sample 2-C. In the item of "beautiful", since the ranking of the 1st place to the 3rd place has uncertainty, when it is excepted, it differs from comprehensive evaluation in that

sample 3-B ranked 1st at Step 3 Since the evaluation values of three items of the sample A is high on the whole, it is thought that the comprehensive evaluation values of the sample A ranked 1st at all the steps. About "authentic" thought as important especially in this research, the samples of the woodgrain by original new print method were the 1st place in three steps other than step 2.

At Step 2 and Step 4, in spite of having used the same woodgrain, ranking changed. It is thought that this result is because the color of the sample A of Step 2 and Step 4 changed with variations in printing. It seems that this factor is applied also to the difference as the results of the item of the "high-class" in Step 2 and Step 4. From the above thing, it is considered that there is almost no difference between evaluation by the sheets and evaluation with the boxes.

Table 9: Ranking of each step (high-class)

High-class	Step1	Step 2	Step 3	Step 4
1st	D (0.351)	C (0.364)	A (0.422)	A (0.453)
2nd	A (0.283)	A (0.328)	C (0.348)	C (0.280)
3rd	C (0.222)	B (0.308)	B (0.230)	B (0.267)
4th	B (0.145)			

Table 10: Ranking of each step (beautiful)

Beautiful	Step1	Step 2	Step 3	Step 4
1st	B (0.293)	A (0.591)	B (0.407)	A (0.562)
2nd	D (0.278)	B (0.247)	A (0.382)	B (0.254)
3rd	A (0.277)	C (0.163)	C (0.211)	C (0.184)
4th	C (0.152)			

6.2. Difference in Evaluation by Ages

In order to clarify the difference of the result depended on the participant's attribute, analyses were conducted for every age, and the samples of the 1st place of each result were made into the table (Table 11). In addition, when the difference of the value of the 1st place and the 2nd place was 0.01 or less, the sample of the 2nd place was also shown. In order that there may almost be no difference of the 1st place and the 2nd place in the results of Step 3 and 4 of the group of 50's, and the result of Step 3 of the group of over-60, it seems that the 2nd place is equivalent to the 1st place. When the results of every evaluation item were compared, the results of "authentic" and "high-class " had little dispersion, and the dispersion was large to the results of "beautiful". Therefore, about "beautiful" item, the dispersion in participant's judgment is large. Moreover, it is thought that the dispersion has the tendency for the higher age to be stronger. The other difference is the point that tendencies differ in the older age and younger age bordering on 40's in the results of "high-class" (Table 12). It is thought that the sense of values about "high-class" is divided according to age. The clear difference for every age was not seen at the result of "authentic".

Table 11: 1st place sample of each age（comprehensive evaluation）

Comprehensive evaluation	Step1	Step 2	Step 3	Step 4	Step 5
20’ s	A (0.329)	A (0.532)	A (0.488)	A (0.635)	A (0.423)
30’ s	D (0.383)	A (0.486)	A (0.515)	A (0.530)	A (0.378)
40’ s	D (0.342)	A (0.484)	A (0.387)	A (0.550)	A (0.301)
50’ s	A (0.333)	C (0.363)	C (0.369) A (0.364)	A (0.362) C (0.360)	A (0.351)
over-60	C (0.287)	C (0.390)	C (0.372) A (0.369)	A (0.394)	A (0.313)

6.3. Differences in Evaluation by Gender

Analyses according to genders were conducted and the result was compared. The differences between male and female were not seen at the comprehensive evaluation results of Step 1 to Step 4, and the result of Step 5, they were the same as that of the whole participant's results. Male and female results were compared for every evaluation item. The difference with the whole participant's result was not seen at the result of "authentic ". However, the difference in genders was seen about "high-class" at the result of Step 2 (Table 13). Step 2 and Step 4 use the same printings, and only the conditions of the state of sheets and the state of boxes differ. The color of the sample A changed with variations in printing, and the sample A used at Step 2 was printed more brightly than the sample A of Step 4. At Step 4, although there is no difference, evaluation changes with genders about the color of the sample A of Step 2. In Step 2, female evaluated the sample A of the bright color lower than a male. The difference of genders was not seen in the other results.

Table 12: 1st place sample of each age（high-class）

High-class	Step1	Step 2	Step 3	Step 4
20’ s	D (0.388)	A (0.494)	A (0.510)	A (0.580)
30’ s	D (0.460)	A (0.429)	A (0.523)	A (0.443)
40’ s	D (0.347)	C (0.419)	A (0.400)	A (0.481)
50’ s	A (0.300)	C (0.406)	C (0.436)	C (0.433)
60’ s	C (0.367)	C (0.440)	C (0.418)	A (0.418)

Table 13: 1st place sample of male and female（high-class）

High-class	Step1	Step 2	Step 3	Step 4
Male	D (0.391)	A (0.409)	A (0.466)	A (0.511)
Female	D (0.319)	C (0.421)	A, C (0.387)	A (0.407)

7. CONCLUSION

The analyses clarified the following features:

1.The woodgrain patterns printed with the new printing method obtained high score in the “authentic” and overall evaluations; (The difference between 4-color printing and 7-color printing was judged.)

2.Different age groups and genders demonstrated different evaluation tendencies in assessing the “beautiful” and “high-class” features;

3.No significant difference was observed between the evaluations for sheets and boxes;

4.As for the printing method for the box side, participants found it more authentic-looking when the pattern on the top seamlessly continues to the side.

5.The “high-class” evaluation item was found to be prioritized above the “beauty” and “authenticity”.

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