1. INTRODUCTION

Why do hand drawn lines communicate warmth? Print pattern design within the textile industry refers to repeated patterns or motifs on fabric. In terms of the practical design process, textile pattern designers are emotionally expressive or sensitive like painters, although they work in an industrial design field [1]. Characteristically, the process begins with a designer’s drawing. In recent years, however, the computational design process has been widely adopted by many textile companies to facilitate productivity and manage production costs in Japan. Moreover, many fabric-dyeing factories had to terminate operations for economic reasons. By contrast, several fabric/domestic apparel brands with original hand drawn designs are appearing in the Japanese marketplace. The Finnish fabric company Marimekko, known for its bold, artistic hand drawn patterns, has gained popularity rapidly. According to Marimekko’s 2009 annual report [2], Japan was one of its largest export countries. This phenomenon illustrates the demand for hand drawn patterns, which can be attributed to consumers who view them as more attractive than patterns drawn by computer. Thus, a hypothesis is that the popularity of those brands can be attributed to the design process. Although research on patterns and textiles is conducted frequently [3-6], studies which focus on the process of designing patterns are few. This survey aims to reveal evaluation tendencies and extract the positive characteristics of hand drawn lines in pattern design using the semantic differential (SD) method. Six stripe patterns divided into computer drawn or hand drawn categories were used as stimuli. The two reasons for selecting stripe patterns were to show the distortion effects to the examinee and that it has been used as a basic pattern all over the world [7-10]. Hence, large differences in general images for stripe patterns were not anticipated.
Japanese and Finnish examinees were observed to identify commonalities and differences.

2.1 Stimuli

Six pieces of stripe pattern were printed on A4 sheets (210 mm × 297 mm). We selected three widths (2 mm, 10 mm, 20 mm) according to the precedent survey showing that people tend to perceive image differences for stripes if each line is 1.0–1.5 cm wide [11]. Generally, an optical illusion produced from vertical stripes becomes stronger as the stripes become thinner [12]. Therefore, the thinnest stripes (patterns A and A’ in Fig. 1) were 2 mm wide and offered no strong effect of optical illusion. The stripes were equal in length (196 mm) and drawn by either Adobe Illustrator CS3 (a vector graphics software editor for creating straight stripe with precision) and hand drawings. The starting and ending points of all lines were marked by Adobe Illustrator. The three computer drawn stripe patterns were printed. As for hand drawn stripes, lines of the same length were drawn by free hand printed out preliminarily. These hand drawn stripes were scanned and printed on paper as stimuli.

The color gamut of all patterns was set to pure black (printer: canon pixus pro9000, scanner: canon pixus PM950). Three stripes drawn by Illustrator were assigned to pattern A (width: 2 mm), pattern B (width: 10 mm), and pattern C (width: 20 mm). On the other side, hand drawn stripes were assigned to pattern A’ (width: 2 mm), pattern B’ (width: 10 mm), and pattern C’ (width: 20 mm). (See Fig. 1). To avoid order effect, six stripes were shown randomly to each examinee.

2.2 Evaluation questionnaire

Profile questions and scales were printed on A4 papers that were separated from the stimuli. The SD method was used to measure impression evaluation [13]. The examinees responded to the 14 SD scales for six stripe patterns. We selected nine pairs of adjectives from precedent research studies concerning impression and preference trends in patterns [3-5,11,12]. Additionally, five adjectives (active, jolly, confident, vigorous, free) were quoted from references of such fields as children’s art [14], ancient art [15, 16], and finger painting [17] (See Table 1). Works in these fields were painted by hand, and a great number of them have been admired throughout history. Furthermore, their attractiveness has been studied from the standpoint of art criticism and art psychology [14-20]. For instance, Ruth Faison Shaw (1982) explained that finger painting reminds people of childhood experiences by arousing the imagination and perceptions regarding use of the senses and muscles [17]. Hence, we believe people are attracted to art that is hand drawn with unique distortion, characteristic of the fields noted above. In addition, examinees used the adjective [free] in a preliminary experiment. Evaluation forms were written in Japanese for Japanese examinees and in English with an additional sheet containing adjectives in Finnish for Finnish examinees. Each participant was given as much time as desired to complete the evaluation.

Table 1: Selection of adjectives for impression evaluation

<table>
<thead>
<tr>
<th>ENGLISH</th>
<th>JAPANESE</th>
</tr>
</thead>
<tbody>
<tr>
<td>active</td>
<td>dull</td>
</tr>
<tr>
<td>beautiful</td>
<td>美しい</td>
</tr>
<tr>
<td>fashionable</td>
<td>洗練された</td>
</tr>
<tr>
<td>warm</td>
<td>冷たい</td>
</tr>
<tr>
<td>jolly</td>
<td>晴らしい</td>
</tr>
<tr>
<td>luxury</td>
<td>高級感</td>
</tr>
<tr>
<td>nostalgic</td>
<td>優雅な</td>
</tr>
<tr>
<td>sophisticated</td>
<td>洗練された</td>
</tr>
<tr>
<td>confident</td>
<td>自信に満ちた</td>
</tr>
<tr>
<td>physical</td>
<td>身体的な</td>
</tr>
<tr>
<td>current</td>
<td>出来の</td>
</tr>
<tr>
<td>vigorous</td>
<td>運命がある</td>
</tr>
<tr>
<td>free</td>
<td>おとなしい</td>
</tr>
<tr>
<td>likable</td>
<td>好き</td>
</tr>
</tbody>
</table>

Figure 1: Six stripe patterns for stimuli
2.3 Participants

All participants were required to have art and design education experience and normal vision.

- **Japanese group:**
  Composed of 30 native Japanese speakers, including students from University of Tsukuba and other adults (age range: 20–38 years)

- **Finnish group:**
  Composed of 30 native Finnish speakers, mainly students from Aalt University (formerly University of Art and Design Helsinki) and some other adults (age range: 20–39 years)

3. ANALYSIS

3.1 Analysis method

After the data from the questionnaires were summed up, the averages for each adjective and each nationality were calculated to arrive at Impression Assessment Values. Tests for significant differences for the six kinds of stimuli in the assessment included variance analysis and multiple comparisons of three factors related to Impression Assessment Values. Factors were assumed to be pchand (pc drawn/hand drawn: 2 levels), width (width of line A, B, C: 3 levels), and nationality (J = Japanese, F = Finnish). Further, we analyzed the variance of the three dimensional arrangement by repetition measurement for 14 pairs of assessment adjectives. The multiple comparison method was conducted to compare factors and all kinds of combinations, a Bonferroni correction was applied [21]. Items in Table 2 were significant at 5% for pchand, width, and nationality factors.

3.2 Multiple regression analysis of [likable and unlikable] item

From ANOVA and multiple comparison, we get that no factor exhibited a significant difference for the only pair [likable and unlikable]. Hence, multiple regression analysis was carried out to confirm the correlation with other adjective groups. The average was calculated for five items: [PC] PC drawn pattern, [Hand] hand drawn pattern, [widthA] line width of 2 mm, [widthB] line width of 15 mm, and [widthC] line width of 20 mm. These five factor items were dependent variables, and adjective pairs except the [likable and unlikable] item were independent variables. Multiple regression analysis was carried out using the Stepwise method (i.e., step-by-step iterative construction of a regression model that involves automatic selection of independent variables, frequently employed to select useful subsets of variables and to evaluate the order of importance of variables). As a result, the feature value (variable) of 1 to 4 was adopted for each item in the Japanese group, and a correlation with other adjectives was noted. Three items were associated with the pattern of PC painting: [jolly], [beautiful], and [old fashioned]. One item was associated with the hand drawn pattern: [current]. Two items pertaining to the A pattern of narrowest line width were [fashionable] and [jolly]. One item was associated with the B pattern (width of 1 cm): [fashionable]. Five items for [widthC] were [fashionable], [confident] [jolly], [physical], and [beautiful]. On the other hand, the standard regression coefficient $\beta$ and coefficient of determination $R^2$ of the Finnish group were extremely low ($R^2 = 0.11~0.32$). Generally, correlations with other adjective items were not shown. Table 3 shows the results.
4. CONSIDERATION AND CONCLUSION

We investigated the effect of hand drawn line distortion through the evaluation of six stripe patterns; we looked for common tendencies and differences in impression evaluation between Japanese and Finnish examinees. The following major findings were revealed by the results.

4.1 Assessment trend

4.1.1 As to hand drawn pattern

Overall, high ratings were obtained with hand drawn patterns A’, B’, and C’ in three affirmative adjectives of [warm], [free], and [jolly] in both countries. These results indicate the unique positive effect of the hand drawn process on evaluation of stripe patterns. According to Kubo (1947), [jolly] is associated with the children’s art field, and it is the factor that gives a person some degree of recollection by which cheerfulness is felt. In addition, Steiner (1988) suggested that hand drawn lines can be felt with something akin to freedom because of their abstract qualities. Although the theory referred to free drawings of various motifs, the fact that these factors were assessed in the simple stripe pattern is interesting. The characteristic assessment of the hand drawn line was extracted from this experiment. Our results suggest that the effects of the drawing process can be evaluated with adjectives used in reference to children’s art, including finger painting. In other words, it would imply the potential relationship between people’s preferences for patterns and the attractiveness of art pieces. It is evident from the results that most people evaluate hand drawn patterns affirmatively, regardless of nationality.

4.1.2 As to computer drawn pattern

The computer drawn patterns obtained the higher rating for the adjective [sophisticated] in both Japanese and Finnish groups, except for the pair of patterns A and A’. In the case of Finnish people, pattern A’, which had the strongest distortion for hand drawn lines, was evaluated with a higher score than the computer drawn pattern A. The Japanese group evaluated all patterns drawn by computer lower than patterns drawn by hand for the adjective [likable]. Thus, this study showed that consumers’ preferences did not correlate in all cases with the adjectives (including [sophisticated]), which are used in trend research.

4.1.3 As to three kinds of width

The effects of width were observed for the adjectives [fashionable], [confident], and [nostalgic]. It was common for both Japanese and Finnish examinees to evaluate pattern A’ as [fashionable] with a high rating. We observed that the thinner lines were evaluated with higher ratings. Further, evaluations for the adjective [confident] — quoted from children’s art — showed high scores for patterns C and C’ regardless of the drawing process. The same tendency was observed in both Japanese and Finnish groups. In addition, an interesting tendency that correlates with trend research words was observed. Four adjectives [fashionable, luxury, current, sophisticated] were quoted from the precedent pattern that has been noted in trend research. Except for the pairs of [sophisticated], all of these adjectives related significantly to the main fact [width], based on the multiple comparison analysis.

Overall, these results show that the effect of width must be considered from the perspective of design and market trends in each country. However Ishii et al. (1994) have shown that consumers’ evaluation scores may vary depending on the kind of product on which patterns are printed. Therefore, advanced experimental research should be carried out to address this issue.

4.2 Featured differences and results of each examinee group

4.2.1 Japanese group

It is noteworthy that the hand drawn A’ pattern, which should be regarded as primitive, was evaluated as “current” by the Japanese group in 2010. Additionally, the preference for the hand drawn pattern correlated closely with “current” as the result of the multiple regression analysis. We wonder if this is a reflection of Japanese character and the cultural sensitivity to trends or fashion [22].

As for the adjective pair [nostalgic-progressive], Japanese people evaluated hand drawn patterns as nostalgic.

4.2.2 Finnish group

By contrast, the Finnish examinees evaluated both patterns B and B’ as “nostalgic” and with a higher score than other patterns. Moreover, pattern B was evaluated as [likable], though other PC patterns (e.g., patterns A and C) were evaluated as [unlikable]. This trend is consistent with the fact that the width of the “Tasaraita” pattern, which is an iconic striped pattern introduced by Marimekko in 1968 [23], almost fits the width of patterns B and B’.

In light of these considerations, it can be concluded that the impression evaluations of patterns correlated with their industrial backgrounds. From the results for the Finnish group, in which there was no correlation between preference and other adjectives, it can be assumed that the country’s history of print design was accompanied always
The Effect of Hand Drawn Line Distortion on Impression Evaluation of Stripe Pattern

by “art” [24]. However, Japan’s concept of print design has its derivation in the area of craftwork; thus, it has been linked to industry design. Considering that the subject size was only tens of people for this study, it was difficult to conclude actual trends for each country. An understanding of the differences in the countries’ design development histories indicates the suitability of a more constructive study regarding the commonality of loyalty among today’s consumers who prefer the warmth of hand drawing.

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