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WALLPAPER PATTERNS AS AN EXAMPLE**

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## VISUAL IMPRESSIONS OF PAIRED PATTERNS – TAKING WALLPAPER PATTERNS AS AN EXAMPLE

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### Abstract

Two psychophysical experiments were carried out to investigate the relationship between wallpaper patterns and visual impressions. Experiment 1 used single wallpaper patterns as the stimuli, whereas Experiment 2 used wallpaper pattern pairs as the stimuli for the visual assessment. A total of 11 wallpaper patterns were used in this study. Ten 6-point forced choice scales were used in both experiments: simple/complex, warm/cool, relaxing/heavy, comfortable/uncomfortable, lively/dull, unique/common, fashionable/unfashionable, splendid/plain, beautiful/ugly and like/dislike. As a result, principal component analysis identifies two underlying factors of the visual responses for Experiment 1, "liveliness" and "simplicity". The observers tended to prefer wallpaper patterns that appeared beautiful, comfortable, relaxing or lively. They also tended to prefer light patterns to dark patterns. Experiment 2 reveals that the "mean value" method can apply to non-aesthetics-related scales, such as simple/complex, warm/cool, relaxing/heavy, comfortable/uncomfortable, lively/dull, fashionable/unfashionable and splendid/plain.

*Keywords:* Texture, Pattern, Wallpaper, Visual Impression

### 1 Introduction

Pattern plays an important role in image recognition and preference, as it can affect the user's perception and impression of the image, and can help create desired feeling for the image content and thus enhance image quality. It is unclear, however, as to whether there is a predictable relationship between pattern and its visual impression, and how to select a pattern to create a specified visual impression when paired with an existing pattern. As an initial attempt in this area, the present study used wallpaper patterns as an example with a context of house decoration, to investigate the relationship between pattern and the corresponding visual impressions.

### 2 Methods

To achieve this aim, two psychophysical experiments were carried out. Experiment 1 used single wallpaper patterns as the stimuli for visual assessment, whereas Experiment 2 used wallpaper pattern pairs as the stimuli. A total of 11 wallpaper patterns were used in Experiment 1. These patterns were selected from the most commonly used wallpapers existing in a local region: (1) a pattern consisting of Chinese calligraphy and a Chinese painting of plants, (2) a pattern imitating wood texture, (3) a pattern imitating fabric texture, (4) a pattern imitating rock texture, (5) a pattern consisting of drawings of Western architecture and stamps, (6) a pattern imitating metal texture, (7) a one-side-continual pattern of straight lines, (8) a two-side-continual pattern of circles, (9) a two-side-continual Baroque pattern, (10) a drawing of a flower and (11) a pattern imitating brick texture. All wallpaper patterns were achromatic. Each pattern had two lightness versions, light and dark, resulting in a total of 22 wallpaper patterns, serving as test images in the present study. Figure 1 shows the 11 wallpaper patterns used in Experiment 1.



**Figure 1 – The 11 achromatic wallpaper patterns used as the stimuli for Experiment 1**

Ten 6-point forced choice scales were used in Experiment 1 for visual assessment of each wallpaper pattern: simple/complex, warm/cool, relaxing/heavy, comfortable/uncomfortable, lively/dull, unique/ common, fashionable/unfashionable, splendid/plain, beautiful/ugly and like/dislike.

A panel of 34 observers, including 18 males and 16 females, all university students with normal colour vision, participated in Experiment 1. During the experiment, each observer was asked to view the 22 wallpaper patterns presented individually in random order on an EIZO ColorEdge CX270 liquid-crystal display, situated in a darkened room. The 22 wallpaper patterns were all replicated for each observer.

Experiment 2 used wallpaper pattern pairs, instead of single wallpaper patterns, as the stimuli. Out of the 231 pairs, which consisted of all possible combinations of the 22 wallpaper patterns used in Experiment 1, only 20 pairs were selected as the stimuli for Experiment 2. These 20 pairs were selected to cover a wide variety of responses for each scale according to results of Experiment 1. Figure 2 shows the 20 pattern pairs used in Experiment 2.



**Figure 2 – The 20 pattern pairs used as the stimuli for Experiment 2**

A total of 11 semantic scales were used in Experiment 2 for the visual assessment. These 11 scales consisted of the 10 scales used in Experiment 1 and an additional scale, harmonious/disharmonious. A panel of 32 observers, including 15 males and 17 females, all university students with normal colour vision, participated in Experiment 2. The 20 wallpaper pattern pairs were all replicated for each observer. Experimental procedures and viewing conditions for Experiment 2 were all the same as those for Experiment 1 except for the stimuli, as described above. The categorical judgement scaling method was used for data collection and analysis for both experiments.

### 3 Results

According to results of Experiment 1, like/dislike is correlated closely with beautiful/ugly ( $R=0.98$ ), comfortable/uncomfortable (0.94), relaxing/heavy (0.92) and lively/dull (0.92), as shown in Table 1. This suggests that the observers tended to prefer wallpaper patterns that appear beautiful, comfortable, relaxing or lively. The 22 wallpaper patterns were ranked in order of like/dislike, and the result shows that the observers tended to prefer light patterns rather than dark patterns.

**Table 1 – Correlation coefficients between the 10 scales used in Experiment 1**

	simple	warm	relaxing	comfortable	lively	unique	fashionable	splendid	beautiful	like
simple		0.41	0.47	0.40	0.19	-0.02	0.51	-0.09	0.24	0.25
warm	0.41		0.97	0.95	0.89	0.56	0.66	0.63	0.87	0.89
relaxing	0.47	0.97		0.96	0.86	0.55	0.65	0.56	0.89	0.92
comfortable	0.40	0.95	0.96		0.87	0.59	0.65	0.64	0.94	0.94
lively	0.19	0.89	0.86	0.87		0.82	0.73	0.83	0.90	0.92
unique	-0.02	0.56	0.55	0.59	0.82		0.53	0.75	0.74	0.72
fashionable	0.51	0.66	0.65	0.65	0.73	0.53		0.71	0.64	0.69
splendid	-0.09	0.63	0.56	0.64	0.83	0.75	0.71		0.71	0.74
beautiful	0.24	0.87	0.89	0.94	0.90	0.74	0.64	0.71		0.98
like	0.25	0.89	0.92	0.94	0.92	0.72	0.69	0.74	0.98	

Principal component analysis identifies two underlying factors of the visual responses for Experiment 1, "liveliness" and "simplicity", standing for 86.75% of the total variance. "Liveliness" is correlated closely with all but the simple/complex scale, and has the highest correlation coefficient ( $R=0.95$ ) with lively/dull, followed by like/dislike (0.92), splendid/plain (0.91) and beautiful/ugly (0.91). "Simplicity" is correlated with only simple/complex ( $R=0.95$ ). The two underlying factors, "liveliness" and "simplicity", are recommended to study further in the texture research area.

Visual responses obtained from Experiment 2 were compared with those obtained from Experiment 1. The former were visual responses for each of the 20 pattern pairs. The latter were a set of predicted values for each scale, determined by the mean value of visual responses for the two patterns in the given pair. According to the comparison results, most of the scales show high correlation coefficients, such as splendid/plain ( $R=0.88$ ), relaxing/heavy (0.87), lively/dull (0.86) and fashionable/unfashionable (0.84). Only three scales show low correlation coefficients, including unique/common ( $R=0.34$ ), like/dislike (0.35) and beautiful/ugly (0.39). The results seem to suggest that the "mean value" method does not apply to aesthetics-related scales.

The additional scale in Experiment 2, harmonious/disharmonious, was found to correlate closely only with like/dislike ( $R=0.90$ ) and beautiful/ugly (0.84), two of the aesthetics-related scales. This implies that the harmonious/disharmonious scale may not be predicted well using the "mean value" method described above.

#### 4 Conclusion

Results of Experiment 1 show that the observers tended to prefer wallpaper patterns that appeared beautiful, comfortable, relaxing or lively. They also tended to prefer light patterns to dark patterns. Experiment 2 reveals that the "mean value" method can apply to non-aesthetics-related scales, such as simple/complex, warm/cool, relaxing/heavy, comfortable/uncomfortable, lively/dull, fashionable/ unfashionable and splendid/plain. Findings of this study may help develop new guidelines for wallpaper pattern design.