ASSOCIATION BETWEEN COLORS AND EMOTIONS BY MEANS OF WORDS AND FACE ICONS

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Abstract

Color plays an important role in visual communication. In this study we examine the association between emotional words, as well as face icons, and colors. In our experiment, participants were first presented with 7 words used to express 7 basic emotions, respectively, as defined by Ekman and 'no emotion', and asked to choose colors from a color palette presented on an LCD display to associate with the words. The same color association procedures were also applied to a set of face icons designed to represent 7 basic emotions. The color palette with 130 colors was designed based on the PCCS color system concept. From the results, some associations between colors and emotions were found.

Many studies investigating the association between colors and emotions have been conducted, mainly in design fields, by means of factor analysis (Manav, 2007; Ou, 2004). Our study focuses on this association for countenance of the face icons. In our pilot study, using a color naming method that involved the 7 emotional words 'joy', 'sadness', 'anger', 'fear', 'surprise', 'disgust' and 'no emotion', particular colors (red and blue) were associated with some emotional words. For example, many participants selected red for 'anger'. Accordingly, there should be strong connection between 'anger' and red. Likewise blue was connected to 'sadness'. These support the result of Suzuki, et. al. (1996) conducted by using pictures of facial expressions and 8 color samples. On the other hand, the selections for the other emotional words were not centralized. However, they showed trends: colors with lower saturation or/and lower brightness were selected for 'fear' and 'disgust', whereas colors with higher brightness or/and higher saturation were selected for 'joy', matching the results of Manav (2007). In our present study, we used a color palette with 130 colors, which was designed based on the PCCS Color System. Moreover, 7 face icons designed to represent 7 basic emotions were added as stimuli, and the same color association procedures were applied to the set of face icons. From the results, some associations between colors and emotions were found in both conditions.

Method

Apparatus and stimuli

The color palette was designed based on the PCCS Color System. The 130 color samples were located in a matrix with 13 columns × 10 lines. The columns showed hue: bluish purple/purple, purplish blue, blue, blue green, bluish green, yellowish green, greenish yellow, reddish yellow/yellow, orange, yellowish red, purplish red/red, reddish purple and grey. The lines showed brightness, with the highest brightness at the top (Fig. 2). The color palette was presented on an LCD display so that participants could see all the color samples at once. The

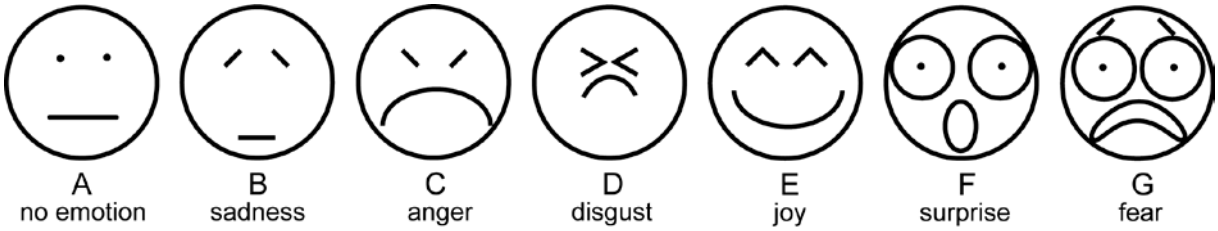


Fig. 1. Face icons used as stimuli in this experiment.

size of each color sample on the palette was 15 mm × 15 mm. The display was viewed in a dimmed booth at a viewing distance of approximately 55 to 70 cm, and the background of the color samples was 18% grey. Six focal colors, red (Vivid-2 of PCCS, E11 on the present color palette), orange (Vivid-5, E9), yellow (Vivid-8, D8), green (Vivid-12, F5), blue (Vivid-18, G3) and purple (Vivid-22, G1), were located on the palette, and each focal color was adjusted as closely as possible to the CIE values of PCCS color samples. The color samples were calibrated by chromatic photometers (Minolta, CS-100; Minolta, CA-100). The color palette was presented on a 19-inch LCD display (Sony, SDM-S93/HK) with 60-Hz refresh rate and 1,280×1,024 pixel spatial resolution. The top, back, left and right sides of the display were covered so that the light of the room could not affect the display screen. The set of face icons designed to represent 7 basic emotions was based on Ekman's face expressions (1969) (Fig. 1). The 7 basic emotional words were presented in Japanese.

Participants and procedure

There were 30 study participants, including 15 males and 15 females. The mean age was 26.9 years, with a range from 20 to 47; the males' mean age was 26.4 years, and the females' mean age was 27.1 years. They all were Japanese and were given their informed consent basis at the beginning of the experiments. The experiment consisted of two sessions. The initial session was color association with 7 emotional words, and the following session was color association with a set of 7 face icons. The participants' task in the color association procedures was to imagine colors and choose them from the color palette. An experimenter first presented a summary of the experiment to a participant and delivered answer sheets; in the initial session, each emotional word was presented on the answer sheet, and the experimenter asked the participant to imagine colors associated with the word. After the participant had colors in mind, the experimenter presented the palette on the LCD display and the participant told what color he/she imagined, pointing at the appropriate color samples on the palette. The experimenter marked the chosen color samples on the display, and the participant wrote down the marked colors on the answer sheet. The participant weighed the marked colors according to the intensity of the image in his/her mind. Answers were divided as parts of 100% in weight among selected colors. For example, if a participant selected four color samples, E2, E3, E8 and F8 for the word 'disgust', the participant might weigh the association as follows; E2 (70%) + E3 (20%) + E8 (5%) + F8 (5%) = 100%. The order of presenting the 7 emotional words was randomized among participants. After participants had completed the initial session, we conducted the next session for face icons. The participants could take a rest between sessions if they wanted to. In the following session, a face icon (diameter 7.7 cm) was presented on the board, and participants were asked to imagine the face color of the icon. The same procedures as were used in the initial session were applied to a set of face icons. The order of presenting the 7 face icons was randomized among participants. At the end of this session, participants answered questionnares to evaluate what emotions they felt the icons expressed by multiple selection from 7 basic emotions.

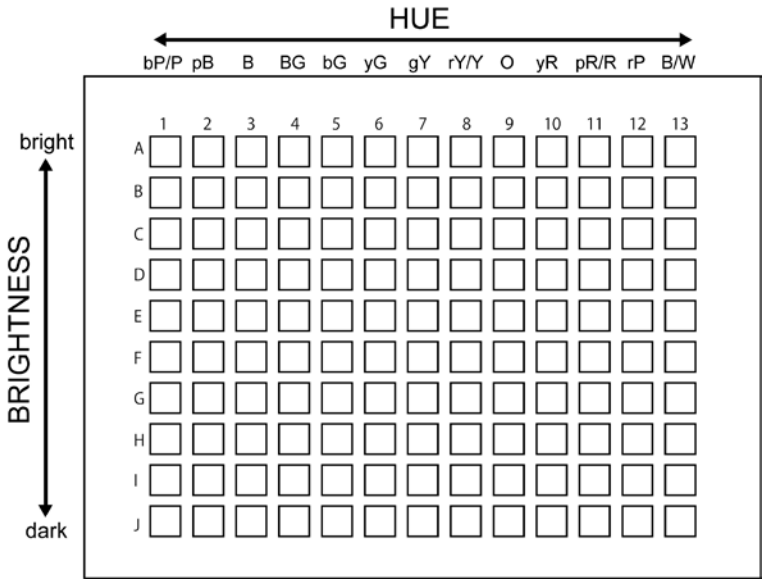
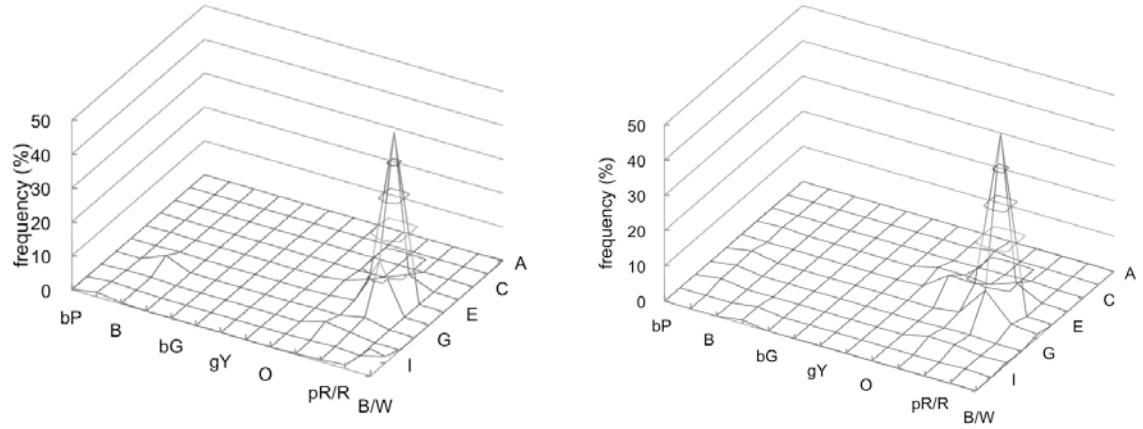


Fig. 2. Color palette presented on the LCD display.

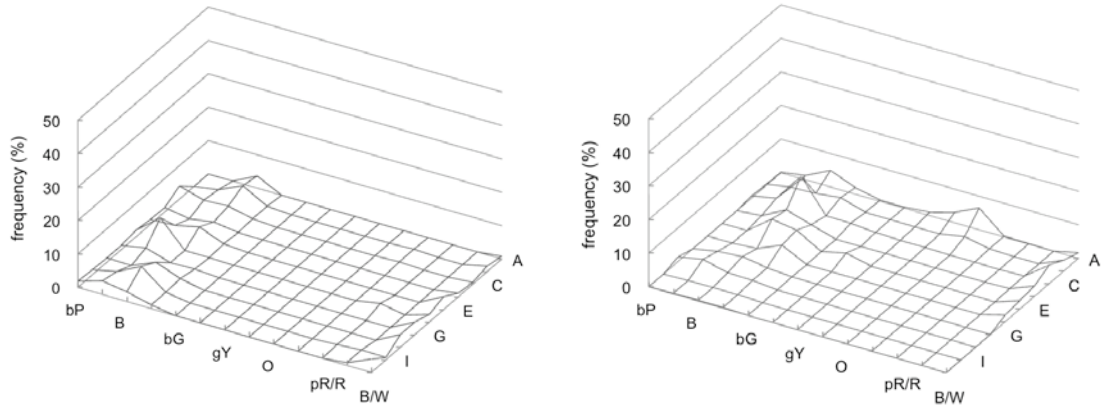
Table 1. The CIE values of color samples on the palette were calibrated by chromatic photometer, the top lines as x, middle ones as y and bottom ones as Y (cd/m^2).

	1	2	3	4	5	6	7	8	9	10	11	12	13
	0.321	0.307	0.286	0.288	0.305	0.344	0.363	0.376	0.366	0.372	0.362	0.350	0.325
A	0.300	0.287	0.324	0.333	0.347	0.375	0.371	0.359	0.339	0.328	0.303	0.288	0.332
	74.2	67.1	71.5	87.5	82.6	81.4	94.0	89.7	72.9	74.9	67.8	72.3	108.0
	0.318	0.285	0.265	0.272	0.288	0.349	0.378	0.382	0.400	0.359	0.391	0.348	0.320
B	0.270	0.254	0.305	0.327	0.364	0.402	0.392	0.384	0.352	0.339	0.300	0.285	0.326
	62.2	53.1	68.0	80.2	82.5	85.5	92.4	91.4	71.8	64.9	57.8	65.8	92.0
	0.313	0.263	0.241	0.253	0.276	0.354	0.382	0.406	0.429	0.437	0.422	0.365	0.322
C	0.254	0.234	0.272	0.329	0.385	0.425	0.418	0.396	0.360	0.338	0.302	0.263	0.320
	46.6	42.0	52.2	68.0	77.0	77.9	82.4	82.7	63.1	49.0	49.4	52.9	61.8
	0.301	0.235	0.207	0.23	0.267	0.351	0.402	0.458	0.482	0.503	0.478	0.386	0.319
D	0.222	0.194	0.244	0.319	0.412	0.475	0.447	0.466	0.377	0.35	0.3	0.248	0.315
	39.1	30.3	41.9	66.6	70.5	73.6	83.1	85.3	54.1	41.3	39.2	44.7	47.5
	0.274	0.196	0.177	0.238	0.268	0.355	0.389	0.467	0.547	0.572	0.614	0.404	0.316
E	0.189	0.147	0.205	0.319	0.388	0.439	0.433	0.446	0.385	0.381	0.321	0.231	0.313
	24.2	17.6	27.5	45.8	48.8	48.7	56.1	62.3	40.3	29.9	19.6	31.4	37.1
	0.277	0.198	0.178	0.207	0.256	0.351	0.414	0.463	0.544	0.459	0.554	0.390	0.314
F	0.185	0.145	0.206	0.299	0.449	0.514	0.476	0.447	0.397	0.344	0.303	0.226	0.314
	17.40	11.60	18.10	34.20	37.00	36.10	44.40	40.40	23.20	23.10	16.20	19.70	26.60
	0.296	0.224	0.177	0.214	0.252	0.362	0.404	0.435	0.493	0.514	0.482	0.370	0.310
G	0.183	0.161	0.191	0.298	0.394	0.476	0.462	0.441	0.394	0.360	0.283	0.222	0.308
	12.7	11.2	13.4	26.2	27.7	30.0	32.2	31.5	20.3	16.9	13.9	16.0	19.1
	0.288	0.220	0.192	0.214	0.250	0.361	0.412	0.445	0.494	0.532	0.489	0.365	0.311
H	0.192	0.161	0.223	0.296	0.399	0.488	0.459	0.438	0.395	0.359	0.289	0.221	0.305
	10.4	71.5	10.9	19.1	17.9	18.2	23.4	20.3	13.2	10.3	8.69	10.4	11.9
	0.283	0.239	0.212	0.221	0.260	0.362	0.383	0.403	0.440	0.458	0.428	0.336	0.321
I	0.207	0.186	0.238	0.321	0.369	0.434	0.440	0.422	0.379	0.344	0.286	0.229	0.308
	7.78	6.32	8.63	12.9	12.0	12.3	14.9	14.2	9.83	8.02	7.02	7.83	5.26
	0.282	0.230	0.206	0.225	0.262	0.343	0.386	0.406	0.445	0.476	0.444	0.346	0.311
J	0.206	0.184	0.227	0.322	0.390	0.454	0.439	0.420	0.377	0.337	0.298	0.235	0.293
	4.43	3.35	4.06	8.07	6.60	6.35	8.82	7.46	4.68	4.38	3.62	4.02	0.38

(a) Anger



(b) Sadness



(c) Joy

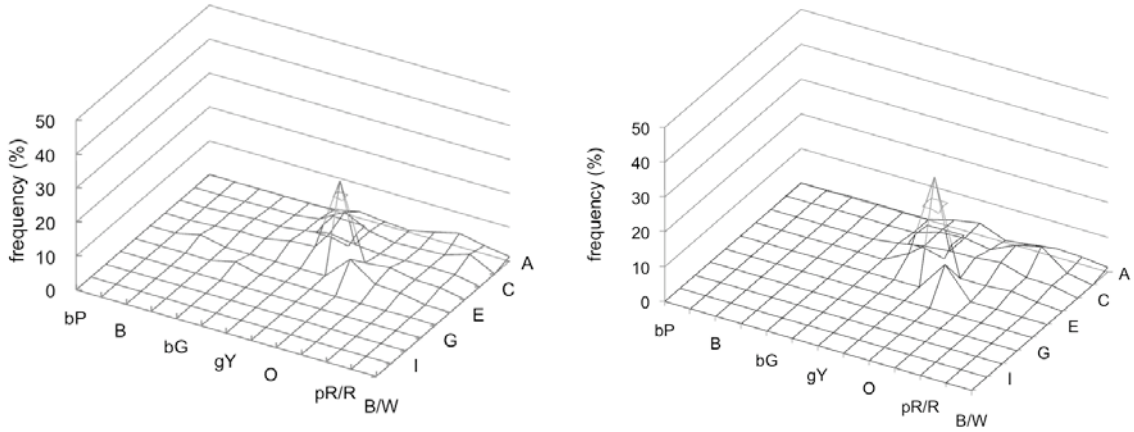
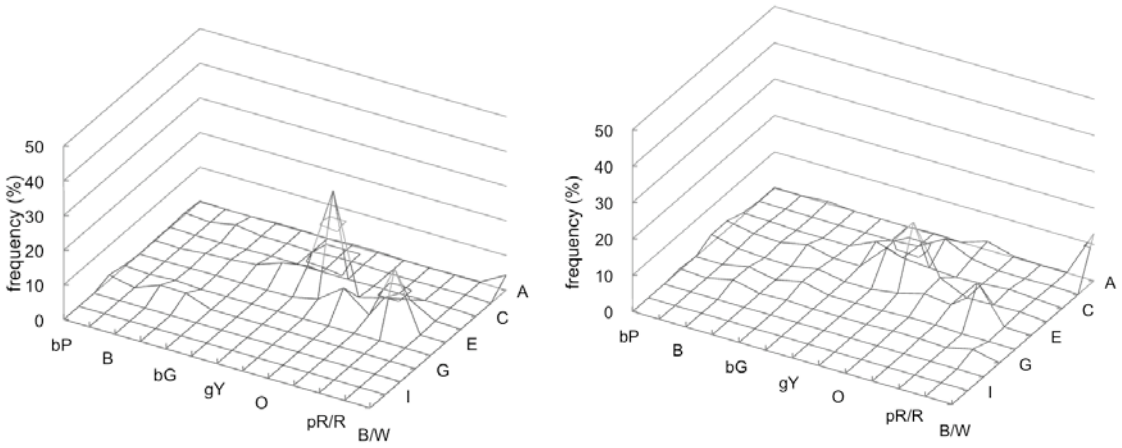


Fig. 3. Averages of response frequency. The left column shows the responses for words, and the right column shows the responses for face icons. The lines give the results of emotions: (a) anger at the top, (b) sadness in the middle, (c) joy at the bottom. These responses for the words tended to be similar to those for the face icons.

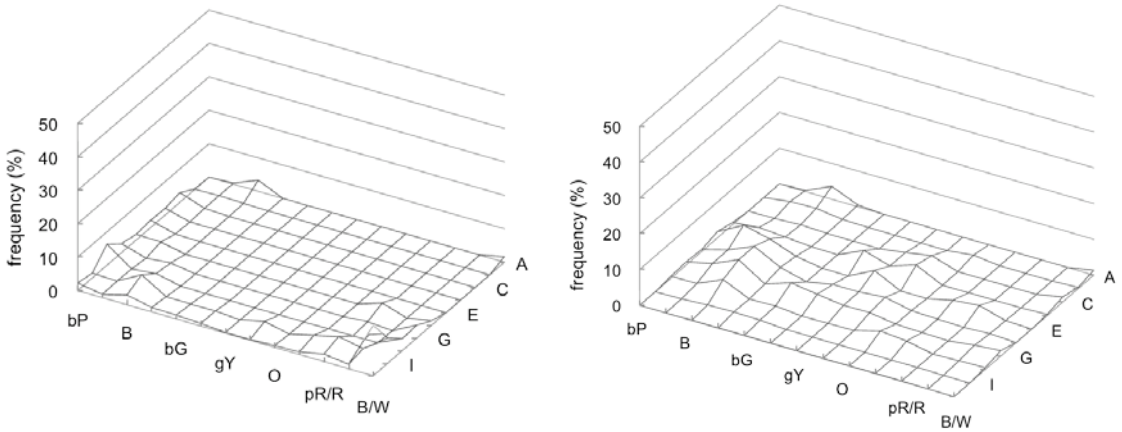
Results and Discussion

Figure 3 shows the averages of response frequency. The left column shows the responses for words, and the right column shows the responses for face icons. The lines give the results of

(a) Surprise



(b) Fear



(c) Disgust

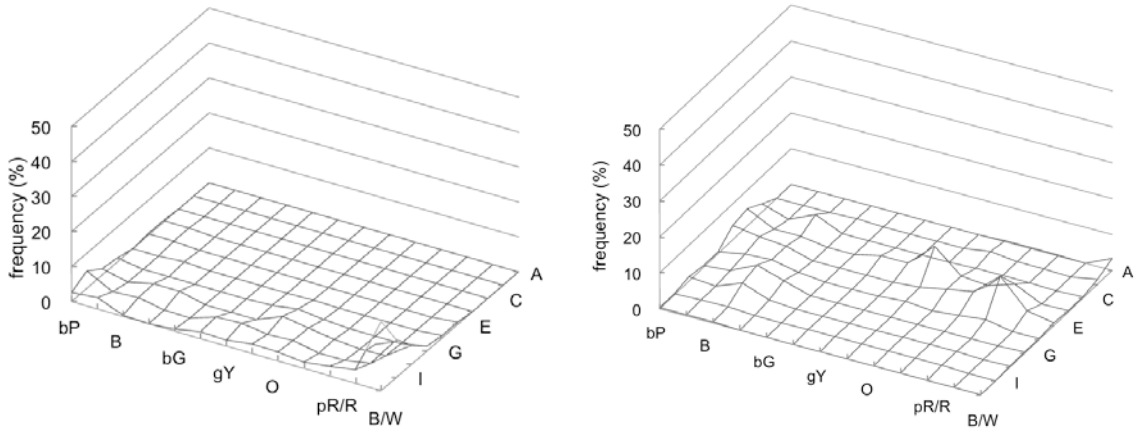


Fig. 4. Averages of response frequency. The left column shows the response for words, and the right column shows the response for face icons. The lines give the results of emotions: (a) surprise at the top, (b) fear in the middle, (c) disgust at the bottom. These responses for the words are not similar to those for the face icons.

Table 2. The results of evaluation for face icons. The table shows the frequency with which the participants associated the given emotions with each face icon.

face icon	no emotion	joy	sadness	anger	disgust	surprise	fear	others
No emotion (A)	28	1				2	1	6
Joy (E)		30	1					2
Sadness (B)	3		23		3		3	14
Anger (C)				30	3		1	1
Disgust (D)			7	7	10	3	2	19
Surprise (F)		1				30	2	3
Fear (G)			15		9	14	7	14

emotions: (a) anger at the top, (b) sadness in the middle, (c) joy at the bottom. These responses for the words tended to be similar to those for the face icons. In (a) anger, the graphs of both conditions are very similar, and both have remarkable peaks (word: 48.86%, icon: 51.91%) at vivid red (E11 on the present color palette). In (b) sadness, although the frequencies are not centralized, low frequencies are present widely from purple to blue green through all range of brightness. Additionally, in the icon condition, brighter skin colors (A8: 3.05%, A9: 6.46%) were chosen. According to table 2, many answers in the ‘others’ choice involved poor health condition, and thus these colors might be connected to poor health condition, too. In (c) joy, both conditions had very similar results, and they have modes at the same samples, that is, D8 as vivid yellow (word: 24.40%, icon: 28.10%). For these three emotions, the icons are associated with the represented emotions, which appear to underscore the similarity between the conditions. The results of (a) and (b) suggest that anger is associated with red and sadness is associated with blue, including bluish colors in both conditions. These results support the results of Suzuki (1998). We would achieve the same results using a palette with even more color variations. Figure 4 shows the averages of response frequency in (a) surprise, (b) fear and (c) disgust. These are not similar between conditions. In (a) surprise, the mode of the icon condition is lower, though the modes of both conditions are the same at D8 (word: 29.44%, icon: 16.86%). In the icon condition, the response range is widened to bright bluish colors, skin colors and white. This may be affected by culture because there is a Japanese expression for surprise 'Gan-men So-Haku' (pallor of the face). According to Ekman (1969), the facial expression used to show surprise is influenced more by culture than are other facial expressions, which agrees in part with our results. In (b) and (c), the results are different between conditions. The emotions felt for these icons were decentralized (see Table 2). The results of the present study suggest that the association between colors and emotions is variable, depending on the emotion.

References

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