Relation of Color Emotion and Meaning of Figure(Alphabets) in Art Education

Masanori Anegawa [1] and Akiko Anegawa [2]

[1]*Nakamura Gakuen University, Japan*
[2]*Saga Municipal Fuji Elementary School, Japan*
1masanori@anegawa.com, 2akiko@anegawa.com

1. Introduction

The authors have been conducting a "Study of Color in Art Education" for some time now. In our recent study, we have investigated "Relation of Color and Emotion in the Picture Book in Art Education -Picture Book Series of Miffy in This Study-". The result showed that the positive values for associated terms become higher in the order of color (original picture book image), outline (monochrome) and gray scale. Therefore it was clarified that impressions people get from picture books are affected by color and brightness. Also, in this previous study, the influence of color widely varied depending on whether the figure had a clear meaning or not.

In the present study, an experiment was conducted with a large number of subjects to examine impressions that subjects get from multiple simple figures by rotating them and changing their colors. The results showed that the rotation and color of figures deemed meaningful or figures similar to them gave the subjects widely varied impressions. However, the rotation and color of figures deemed meaningless or figures similar to them did not give the subjects widely varied impressions. It was evident from these findings that the semantic element of figures has strong association with color.

This study included 26 types of capital letters of alphabets, A to Z and changed those colors to research changes in impressions from subjects by an experiment with many subjects. As a result, we found that subjects who were not native speakers of English were less likely to be influenced by the types of letters. However, for changes in colors, the impressions from subjects were significantly changed. Under this experiment, we found that a figure or a letter having a certain meaning was significantly influenced by the color.

In addition, this study is structuring "a learning system of colors and figures using E-Learning (Moodle, an open source of E-Learning system)" for elementary school students and junior high school students based on these study results. In particular, we are creating contents for classes based on textbooks, reviews in classes, complementary teaching materials, and actual cases. We will use this E-Learning for actual classes of arts and crafts, and arts for elementary school students and junior high school students to validate the effect/effectiveness.

2. Experimental Conditions

1) Figure types used for experiment one

As a result of the study in 2016, we found that the impressions from subjects were significantly different between cases in which people can easily associate the meaning with a figure and opposite cases. Accordingly, this study used eight types as shown in Figure 1 including figures that are simple and people can easily associate the meanings, and also figures that people cannot easily associate those meanings as possible.

(a) to (d) are general figures that are utilized for controllers of game devices. In addition, Figure (e) was created by combining two of Figure (d). For Figure (f) and (g), we referred

figures incorporated into Microsoft Office. For Figure (h), it is an original figure by considering "vertical and horizontal asymmetry"/"Fewer sharp vertexes".

2) Figure types used for experiment two

This study further conducted the same experiment as Experiment One to 26 types of capital letters of alphabets, A to Z as figures having meanings as shown in Figure 2. However, we applied only colors of figures while not conducting the rotation of figures as described below.

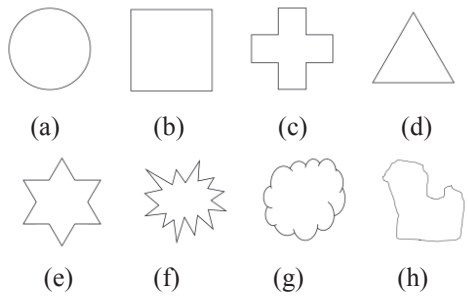

Figure 1. Used Eight Patterns

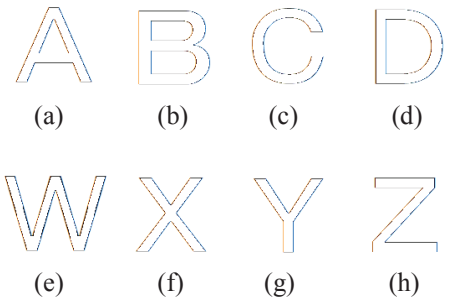

Figure 2. Used Alphabets (A to Z)

3) Rotation of figures used for experiment one

A figure may have another meaning when it rotates. For example, when + mark (Figure3 (a)) rotates by 45 degrees, it turns into x mark (Figure 3 (b)) as shown in Figure 3. Thus, the meaning of a figure may be changed by rotating the figure.

In addition, the rotating angle may be limited (being the same figure after rotating) depending on the symmetry of a figure. In case of figures without symmetry, we rotated by 0, 90, 180, and 270 degrees per 90 degrees. Table 1 shows the angles of figures rotated in this experiment. It is possible to make some changes in impressions from subjects by applying such rotations even the same figure.

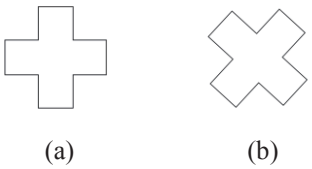

Figure 3. Example of Rotete Figures

Table 1. Used Rotete Degrees

Figure	Roteate degrees	Figure	Rotete degrees
(a) ○	0	(e) ☆	0,45
(b) □	0, 45	(f) ✸	0,90,180,270
(c) ✚	0, 45	(g) ◌	0,90,180,270
(d) △	0,90180,270	(h) ☜	0,90,180,270

4) Colors used experiment one and two

This study applies seven colors as shown in Figure 4 to figures in Figure 1 and 2. Three colors of Figure 4 (a) to (c) consist of achromatic colors: white, gray and black and Figure 4 (d) to (g) consist of chromatic colors: red, green, blue, and yellow. Chromatic colors may not be pure color because we use colors preset in Microsoft Office and the values are identified by RGB (red, green, and blue) in Table 2.

For Experiment One, we apply rotations by angles in Table 1 and apply seven colors in Figure 4 to eight types of figures. Thus, we use (1+2*3+4*4)*7=161 patterns of figures (including different colors) for the experiment. For Experiment Two, we apply seven colors in Figure 4 to 26 types of alphabets. Thus, we use 26*7=182 patterns of figures (including different colors) for the experiment.

(a)White (b)Gray (c)Black
Achromatic of 3 Colors

(d)Red (e)Greeen (f)Blue (g)Yellow
Chromatic 4 of Colors

Figure 4. Used 7 Colors

Table 2. Used RGB Value of 7 Colors

Color	R	G	B	Color	R	G	B
White	255	255	255	Red	255	0	0
Gray	185	185	185	Green	0	176	80
Black	0	0	0	Blue	0	112	192
				Yellow	255	255	0

5) Research items for impressions on figures/colors

This study quantifies by values from one to five (five grade evaluation) to three items of a to c which are contrary associated words in Table 3. Item a and b include associated words mainly about the basic emotions of human while Item c includes associated words about social, moral, and higher level of emotions. We defined these as research items. In addition, this study added Item d to research if figures and colors had a meaning or not in addition to 3 items above. Furthermore, we modified “Hateful (Scary)” to “Not kawaii” in this experiment because the meaning of the associated word became an issue in the previous study.

Table 3. Used Associated Words

Items	5 <=	Value	=> 1
a	happy	<=>	unhappy
b	kawaii	<=>	not kawaii
c	strong	<=>	weak
d	with mean	<=>	without mean

6) Experimental conditions using moodle

This study requires a condition under which 100 people can participate in the experiment at the same time in order to collect objective data. In addition, in order to simplify and automate the experiment as possible, we structured the experimental conditions on Moodle (an open source of E-Learning system) that was regularly used for classes.

In particular, we used the feedback (survey) function of Moodle. In addition, we reduced support for the experiment while improving the comprehension to the experiment and the accuracy of the experiment by structuring the conditions to explain and practice the experiment as well. (Refer to Figure 6.) For the actual experiment, subjects reply to four associated words by five grades per image as shown in Figure 5.

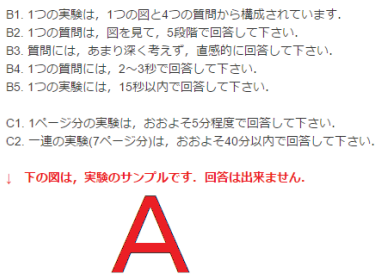

Figure 5. Actual Practice Environment on Moodle

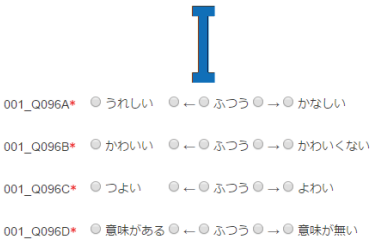

Figure 6. Actual Experimental Environment on Moodle

3. Experiment Results

1) Subject overview of theses experiment one and two

In this experiment, we had time constraints therefore all subjects were university student as shown in Table 4. The experiment results showed no significant difference for gender. Thus, we will submit the summary of data for all subjects regardless of gender for future experiment results. In addition, it took 35 to 45 minutes to "explain the experiment, practice, and experiment" on average, about 40 minutes for many subjects.

Table 4. Subject of This Experiment

		Exp. (1)	Exp. (2)
student	**sex**	**count%)**	**Count(%)**
university	**man**	18 (23.4)	52 (32.5)
	female	59 (76.6)	108 (67.5)
	total	77 (100.0)	160 (100.0)

2) Result overview of experiment one

As the experiment results of Experiment One, Figure 7 shows the average value of the research item d, "With meaning <=> Without meaning" in the vertical axis per figure. The ○ patterns of marks in Figure 7 identify actual colors. In addition, marks shifted from the vertical line to the right side in each figure show rotation angles (four levels at maximum).

Figure 6 showed the following results:

- A value will be significantly different depending on the type of figure.
  * A figure with more sharp vertexes tends to have a higher value.
- The rotation of a figure is less likely to influence the value.
  * In case of △, if we rotate by 180 degrees, it will be ▽
- The values tend to be higher for red and yellow while those tend to be lower for green, blue, and achromatic colors.
- Only for black with x, it shows an exceptionally high value.
  * Black with x strongly associates with cultural (prohibition etc.) meaning.

These results show that the values of "With meaning <=> Without meaning" based on impressions on a figure from subjects are significantly influenced not only by the shape of a figure but also by the color.

As the experiment results of Experiment One, Figure 8 shows the average value of the research item d, "With meaning <=> Without meaning" in the vertical axis per color. The figures in Figure 8 show actual one. In addition, figures shifted from the vertical line to the right side in each figure show rotation angles (four levels at maximum). Naturally, Figure 8 shows the same trend as Figure 7.

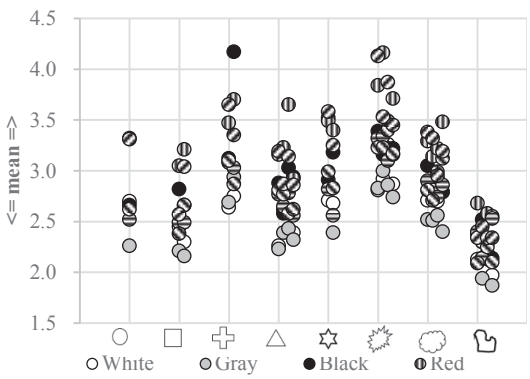

Figure 7. Rate of Meaning by Figure (1)

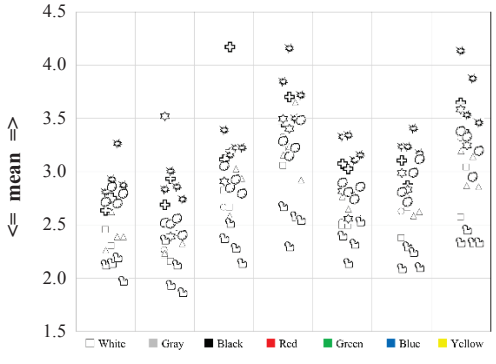

Figure 8. Rate of Meaning by Color (1)

3) Result overview of experiment two

As the experiment results of Experiment Two, Figure 9 shows the average value of the research item d, "With meaning <=> Without meaning" in the vertical axis per figure.

Figure 9 showed the following results:

- The type of a figure (alphabet) is less likely to influence the value.
- The values tend to be higher for red and yellow while those tend to be lower for green, blue, and achromatic colors.

These results show that the values of "With meaning <=> Without meaning" based on impressions on a figure from subjects are significantly influenced more by the color than the shape of a figure in case of subjects who are not native speakers of English.

As the experiment results of Experiment Two, Figure 10 shows the average value of the research item d, "With meaning <=> Without meaning" in the vertical axis per color. The figures in Figure 10 show actual one. Figure 10 shows the same trend as Figure 9.

At the beginning, for Experiment Two, we assumed that the value of with meaning would be higher for figures (alphabets) of S (Excellent)/A (Good)/B (Average)/C (Passing)/D (Failure) used for grading for classes of university students. However, such trend has not been observed especially in this Experiment Two. In addition, as well as figures (alphabets) such as X/Y/X used for mathematics, the value of with meaning was high especially.

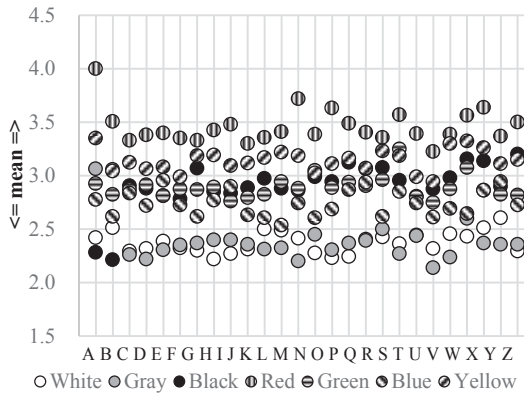

Figure 9. Rate of Meaning by Figure (2)

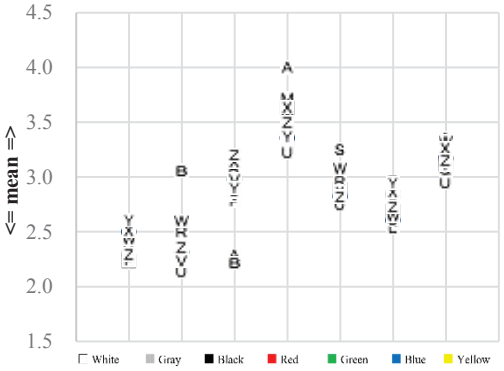

Figure 10. Rate of Meaning by Color (2)

4. Conclusion

This study experimented "the influence by colors between cases in which people can easily understand the contents (meaning) of a picture book (figure) and opposite cases" which was a future issue in the study results in 2016. This study results found the followings:

- A figure that may have a meaning is more likely to be influenced by the color.
- A figure may have a meaning is more likely to be influenced by the rotation.
- Alphabets do not have meanings so much.

* In case of subjects who are not native speakers of English, we found the followings:

- The values entirely tend to be higher for chromatic colors such as red and yellow.
- The values entirely tend to be lower for gray figure.

In this study, we used simple figures as shown in Figure 1 and capital letters of alphabets as shown in Figure 2 for the experiment. It was suggested a color may influence the meaning of a figure (image) for these simple figures as well. Thus, it was assumed that the mutual relationship and influence between the meaning of a figure and the color are more for complicated figures such as actual picture books.

5. Future Issues

This study will continuously work on the followings based on the study results so far.

a. Create works with figures and colors in elementary schools and junior high schools.

b. Implement the education for figures and colors on E-Learning.

c. Recreate works with figures and colors in elementary schools and junior high schools.

Based on these, we will apply and practice the study results/performances obtained from this study to the actual education of arts and crafts, and arts for elementary school and junior high school.

On this occasion, we need to newly create the learning contents for E-Learning and the experimental data. However, we have actual results of the same study in the past (refer to Figure 11 and 12) without a significant problem therefore we consider that these will be able to apply and practice.

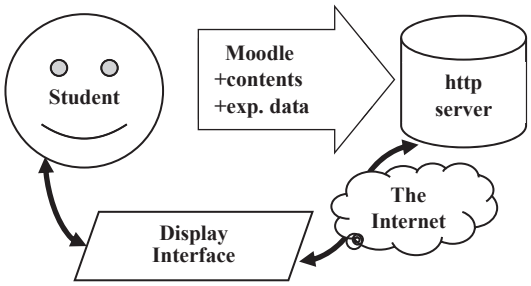

Figure 11. Conceptual Diagram of E-Learning

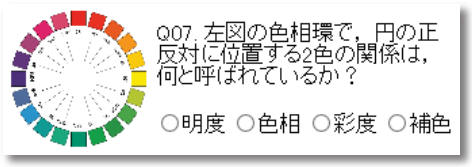

Figure 12. Example of E-Learning

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