

# THE INFLUENCE OF COLOR ON MIND AND BODY COLORING PRACTICE WITH“SELF-CARE-COLORS”

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Today we have diverse viewpoints regarding the relationship between man and color. From the viewpoint that is based on the theory in which color, light and human cells are all waves, I administered the O-ring test and brain wave test, which enabled us to observe some important aspects of the basic man-color-interface. Through this study, we obtained invaluable information on the color arrangement.

## PREFACE

One of the aims of teaching is to help students to fully understand color and to arrange them freely as an element for artistic expression about the influence of color. Color should evoke a sensory experience in students which goes beyond the visual experience through the organs of vision. In other words, there is a physical response to color waves deep within our bodies.

According to F. Birren, muscle tension (der Tonus) changes according to the color of light experienced by the human body. For instance, when the three primary colors, red, yellow and blue, are compared, the tension of the muscles is the highest with red light and lowest with blue. This indicates that parts other than the organs of vision have an ability to respond to waves, and that these parts influence the muscles by precisely manifesting the effects of color on our body. Besides Birren, there have been many other reports about the relationship between color and the body, providing important hints to the full understanding of color.

In practice, the color system is usually explained to students at the introductory stage. This type of curriculum, however, is sometimes harmful since the color system, which is a system of extremely abstracted codes, rapidly grows to become the criterion on which the mind assesses color that is encountered in real life. This brings an imagination gap between sensed colors in everyday life and the abstracted color codes. Although the width that the gap will become depends on the individual talents of each student, it can lessen student's interest in the realm of color.

Although we cannot give classes without explaining effects and phenomena caused by color from conceptual and abstract viewpoints, the point I wish to emphasize here is that the effect of education, color education above all, depends on how effectively we can help students derive pleasure from meeting and discovering something new, which is an ideal stimulant to awaken their hidden sense. In this study I shall show my attempts to get rid of preconceived ideas regarding the sphere of color and consequently to promote new discovery, by introducing a experimental approach to the individual process of understanding color.

For this purpose, I subjected individuals to 1) a muscular strength test (O-ring test), 2) a brain-wave test, and 3) an exercise in color arrangement. These were intended to help students to

gain confidence in the ability to understand color, as well as to feel the reality of color by participating in the experiments. In the O-ring test, subjects were tested to determine which colors strengthened their life force and which did not. (This is due to the T-cell sensor which responds to the waves from color.) In the brain-wave test, body areas responsible for color sensation other than the organs of vision were confirmed. Then, while the impressions of those experiments were still fresh, subjects were given exercises to which the result of the tests were applied.

### **1. Man-Color-Interface**

The main difficulty when observing the influences of color stimulus on the individual lies in the procedures of examination that are based on experimental psychology. First, there is the viewpoint that color is a mere visual stimulus with an abstract concept which tends toward misleading, biased conclusions. Secondly, there is always the possibility of several coincident unspecific factors, such as differences in the size and texture of color materials, the lighting conditions, the distance between the subject and materials, eyesight, color-orientation or shape-orientation or shape-orientation, the visual sensitivity of parts other than the organs of vision, physical condition of the subject, and individual characteristics. Accordingly, the uniformity of the examination conditions and the validity of the criteria for analyzing the results are questionable. Moreover, phenomena that occur within the subject during examination contain material which is unrelated to visual experience. These things tell us that there are many difficulties in specifying the factors that influence color as an object of study, namely the man-color-interface.

For the reasons mentioned above, it is necessary to develop an innovative method for studying the man-color-interface. In his book "The Utility of Color", Junichi Nomura gives us an interesting suggestion with regard to the sensation of color. "Every cell in man has the ability to process data like a computer. According to the latest theory, peripheral cells have the same processing ability as the brain does. For instance, the retina includes peripheral nerves which have nothing to do with sight, and the role of these peripheral cells is to stimulate a pineal gland, and consequently, to promote or control the secretion of enzyme and hormones."

To study the influence of sensory experiences on everyday activities, I focused attention on the response of the body to waves from color. However, there have been few studies based on the wave expanse theory in which light, color and human cells are all waves. As mentioned previously, there lie many difficulties in specifying the influential factors of color, in conventional experimental procedures. Thus, I have adopted the muscular strength test based on kinesiology, and brain wave measurement based on the brain-physiological method, because these procedures are less complicated and kinesiological experiments are believed to directly capture the relationship between man and color accurately.

### **2. The Bi-Digital O-Ring Test**

The Bi-Digital O-ring test (or the O-ring test) was devised by Dr. Hiroaki Omura through his studies in applied kinesiology, and it is well-known as the Omura Test in Japan, the U.S.A. and Europe since it was introduced about twenty years ago. The purpose of this test is to examine

patients or the influence of medicines by checking changes in the muscular strength of the thumb and index finger, since they best reflect changes in the brain and rarely become fatigued. The term“O-ring”was derived from the shape made by these digits.

A great deal of effort has been made to verify the O-ring test through comparison with conventional tests, and as such its accuracy is fairly high. This test enables identification of any changes in the inner organs or in the circulatory system, without the need to consider the subject’s clinical history or use expensive equipment, thereby allowing easy medical application. When used to examine medicines, this test can provide information about effect, toxicity and appropriate dosages.

The main reasons why I have chosen the O-ring test for this study are that students can examine one another in turn and that, in spite of this simplicity of the procedure, they can deepen their understanding of color in unexpected way. Secondly, this test has the great merit of being able to examine matters on a different level to pathological tests.

John Diamond, the first chairman of the Association of Behavioral Kinesiology, also studied the unique function of the thymus and T cells based on the results of his muscular strength test.

Through finding of the fact that the thymus had close relationship with the immunity and that animals grew rapidly when provided with extract of thymus, he found that the thymus functioned as

a factory of white corpuscles. After travelling from marrow to thymus, lymphocytes grow thanks to thymus hormones and then move to lymph nodes and the spleen, where they create another type of lymphocytes that is called as ‘T cells’.

There are various opinions about the functions of T cells and many factors remain as yet unknown. However, one thing which is certain is that T cells distinguish friendly cells from enemies, and destroy unusual cells. S. M. Burnet, a Nobel prize winner, discovered the T cells take part in the destruction of cancer cells. He also discovered that T cells spread throughout all muscles that function as a sensor of life energy. Muscles strengthen when they are close to materials and vibrations which help to strengthen the life energy, and weaken in the vicinity of things which weaken that energy.

Muscles have a very high ability to act as sensors and they bring various information to our body. For instance, the design of products contains something important which affects our decision more than just the aesthetic and artistic points. In his“BK-Behavioral Kinesiology”, John Diamond describes an interesting experiment on muscular strength test using cross symbols, which are believed to raise our life energy. He performed the test on hundreds of

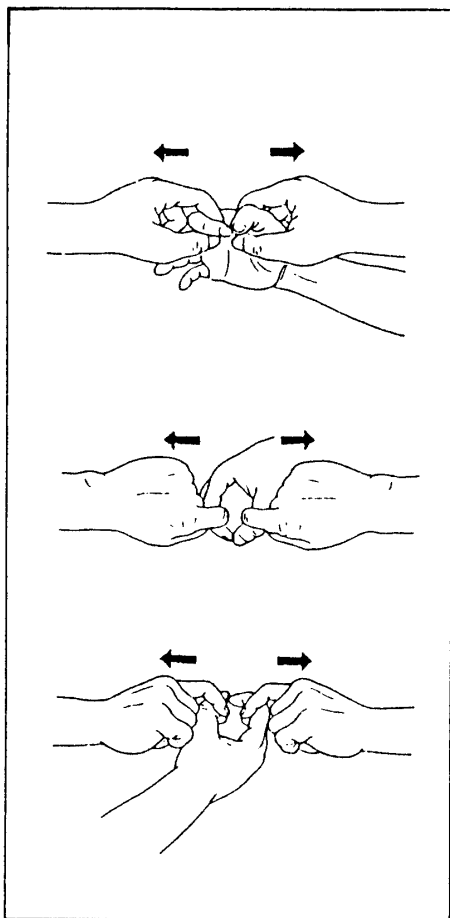


Fig. 1 ) O-Ring test

people hundreds of times, comparing Greek crosses and Latin crosses, and revealed that the length of the lower part of the upright influences the muscular strength, and that the upper part and the horizontal piece are less important. A Greek cross, whose upright and horizontal piece have the same length, which means that it weakens the life energy. I also performed a similar experiment with crosses on my students and obtained almost the same results.

The muscular sensor is also useful to determine which colors strengthen or weaken our life energy. I administered the muscular strength test for several colors, using various shapes and materials for each, in order to distinguish the influence of colors from other factors.

### 2. 1 O-Ring Test Procedure

Both tester and subject should know the correct way to administer an O-ring test.

The subject stretches his dominant hand out slightly below the shoulder, and makes an O-ring with his thumb and index finger, whilst touching or holding an object with the other hand. He should imagine that a distinctive wave (which is created by everything and affects us in a certain way) is transmitted from the object. The subject does not need to concentrate too much, but just let the wave travel to him. He may stand or sit during the test.

The tester also makes an O-ring with each hand, and connects them to the (tester's) ring to form a chain. Then, he pulls the subject's fingers in opposite directions with his O-rings, gradually raising the power until the subject's fingertips separate. Meanwhile, the subject should use his strength and try not to let his fingertips apart.

In the O-ring test, the muscular strength is checked at the moment when the O-ring breaks, and this strength changes depending on what the subject holds in other hand. When he is holding nothing, the strength at separation is called the "zero point", and forms the index value for that subject.

Accordingly, the zero point must be checked carefully. Ideally, the subject should be naked or in white underwear, and tested in a white room furnished with white lights.

Before my students performed the test on color, they were allowed to experiment with salt and sugar to show how obviously the muscular strength changes. By placing some salt on their palms, the subjects usually gain muscular strength and the O-ring becomes hard to open, in other words, they show positive reactions ("+" reactions). On the contrary, with sugar, they lose strength drastically, that is, they



O-ring color-test

show negative reactions (“-”reactions). I find this method very effective for introducing the inexperienced to the O-ring test. However, those who have been practising martial arts for a long time sometimes don’t give negative reactions.

## 2. 2 The O-Ring Color Test

In the O-ring color test, the subjects were one hundred design students (fifty males and fifty females) aged from eighteen to twenty-three years. A total of 42 colors were used as stimuli, namely, six hues consisting of purple(P), blue(B), green(G), yellow(Y), orange(O)and red(R), each of which were classified into seven tones: pale, light, bright, vivid, deep, dull and grayish. The test was carried out with 10-minute intervals after every six colors to avoid subject fatigue. Students were given the following instructions beforehand:

Notes for subjects

- 1) Make an O-ring with the dominant hand and touch the given stimulus colors with the other hand.
- 2) Concentrate on the given object. Do not think about its color nor say to yourself, “This is my favorite color,”or the like.
- 3) Be receptive and let the wave of the color travel through your hand to your body.
- 4) Hold out your dominant hand so that the tester can check your strength easily.
- 5) Be sure to have your zero point checked before moving onto the next color.
- 6) When the muscular strength changes drastically during a color test, start once again from checking the zero point.
- 7) Do not hesitate to take a rest whenever you feel tired or your fingers hurt.

The muscular strength was evaluated using five rating values: + 2, + 1, +/- 0, - 1 and -

2. Then, for comparison, calculations were performed using the following equation:

$$\frac{(\text{sum of “+”rating values}) / (\text{number of “+”subjects})}{(\text{sum of “-”rating values}) / (\text{number of “-”subjects})}$$

(Nine rating values from + 4 to - 4 were used to evaluate the tests with salt and sugar. With colors, however, the change in muscular strength is smaller, so five rating values were adopted for this test.)

### 2. 2. 1 Hue results

a) Purple (P)

Ratios of “+”reactions to “-”reactions were as follows:

6 : 1 for pale P      5 : 3 for light P      4 : 1 for bright P

1 : 3 for vivid P      2 : 1 for deep P      3 : 8 for dull P

3 : 2 for grayish P.

These figures indicate that purple colors with high and middle values relax us and ease stress. For vivid P and dull P, on the other hand, the “-”reaction ratios were higher. This can be explained if we consider that these colors cause the production of T cells which weaken muscular strength and,

consequently, lessen our life force.

b) Blue (B)

Ratios of“+”reactions to“−”reactions were as follows:

3:2 for pale B      7:3 for light B      4:5 for bright B  
 6:5 for vivid B      9:2 for deep B      8:7 for dull B  
 5:11 for grayish B.

As is said that blue is a calming colour, pale B, light B and deep B show excellent positive ratings in this test. In particular, the“+”reaction value for deep blue was astonishingly high, which may be because our body knows it has a curing function.

c) Green (G)

Ratios of“+”reactions to“−”reactions were as follows:

5:6 for pale G      8:1 for light G      5:4 for bright G  
 4:7 for vivid G      7:3 for deep G      8:5 for dull G  
 7:9 for grayish G.

The positive ratings were superior for light G, which was the highest, followed by deep G and dull G. For pale G, vivid G and grayish G, the negative ratings were higher. The overall ratio of“+” ratings to “−”ratings was 44:35. Although the total value of the positive ratings was slightly higher than that for the negative ratings, there was no striking difference between them. This is surprising because green is considered to have the highest curative effect according to data from color therapy, which is in contradiction to the results of this test. A follow-up survey is therefore needed with regard to this point.

d) Yellow (Y)

Ratios of“+”reactions to“−”reactions were as follows:

3:5 for pale Y      2:5 for light Y      14:0 for bright Y  
 3:1 for vivid Y      3:1 for deep Y      4:3 for dull Y  
 5:6 for grayish Y.

The remarkably high value for bright Y is characteristic of yellow and is far higher than expected. The overall ratio was 44:13. It is also worth noting that the rating of +/− 0 reached 17 points, which is second only to the 18 points for purple. As yellow is said to remind us of light and maintains our emotional balance, the results of this test show that bright Y raises the strength of 90% of subjects. Yellow can be described as the guardian color of life.

e) Orange (O)

Ratios of“+”reactions to“−”reactions were as follows:

1:2 for pale O      3:1 for light O      11:0 for bright O  
 13:4 for vivid O      7:5 for deep O      10:3 for dull O  
 5:2 for grayish O.

All colors except pale O show excellent positive ratings. The overall ratio is a striking 58:23, with overwhelmingly few negative evaluations. In line with the accepted view that orange increases the appetite and makes us cheerful, the results of this test indicate that it gives power to life.

f) Red (R)

Ratios of "+" reactions to "-" reactions were as follows:

- 1 : 1 for pale R      1 : 1 for light R      5 : 2 for bright R
- 5 : 6 for vivid R    4 : 3 for deep R      11 : 2 for dull R
- 7 : 6 for grayish R.

The overall ratio was 47:31, showing a rather small difference. Unexpectedly, the positive rating value was highest for dull R, which is the least impressive among the red colors. On the contrary, vivid R, aloud color, may contain a factor which affects our life activity. In general, however, our body does not make light of this color's ability. Red supplies us with force at the appropriate time.

### 2. 2. 2 Tone results

#### a) Pale tone

The overall ratio of positive reactions to negative reactions was 34:28.

The value of positive ratings was lower than expected. While pale P shows an overwhelming majority of positive reactions, the negative rating is greatest for pale Y. It should be noticed that the complementary colors bring opposite reactions. The "-" reactions predominate for warm colors, while "+" reactions are more common for cool colors, which is also an unexpected results.

#### b) Light tone

The overall ratio was 36:20.

The fact that light tones please us is often reported by semantic image analysis. Our test results also show that the value of "+" reactions is almost twice as high as that for "-" reactions. This means that light tones have a good influence on our bodies and emotions, and that our body demands

**Table 1**

- Color papers data
- P. C. C. S. harmony card 42/129 b

hue tone	2 • R		4 • R		8 • Y		12 • G		18 • B		22 • P	
	V	S	V	S	V	S	V	S	V	S	V	S
pale	8.5	3	8.5	3	9.5	3	8.5	3	8.0	3	8.0	3
light	7.5	6	8.0	6	9.0	6	8.0	6	6.5	6	6.5	6
bright	6.0	8	7.0	8	8.5	8	7.0	8	5.0	8	5.0	8
vivid	4.5	9	5.5	9	8.0	9	5.5	9	3.5	9	3.5	9
deep	3.5	8	4.5	8	6.0	8	4.5	8	2.4	8	2.4	8
dull	5.0	6	5.5	6	7.0	6	5.5	6	4.0	6	4.0	6
grayish	4.0	3	5.0	3	6.5	3	4.0	3	3.0	3	3.0	3

V: Value      S: Saturation

it.

c) Bright tone

The overall ratio was 52:15.

This astonishing result indicates that these students subconsciously demand lively colors like those found in carnivals, although they tend to dress rather conservatively as far as I have observed. (They were surprised to learn of their unconscious desire to release their body and soul by wearing bright colors)

d) Vivid tone

The overall ratio was 37:33.

There was difference between the “+” and “-” reactions. Vivid and bright tones lie adjacent on the color scale and have similar semantic images, but the results of this test show an extreme difference in reactions for these two tones. This is an important point to note. As regards vivid colors, our body is easily affected by the distinctive characteristics of each color. The more impressive a color is, the more obvious is the reaction. A slightly less impressive color, however, will drastically change the way our muscular sensors react.

e) Deep tone

The overall ratio was 44:20.

The “+” reactions were predominant, with the difference in value between the “+” reactions and “-” reactions being greater than that for vivid tones and smaller than that for bright tones.

f) Dull tone

The overall ratio was 48:31.

For this tone, the values for both reactions were rather high. A characteristic of dull colors is the very low value of the “+/- 0” reaction (which means that a subject is not influenced by color) : only 5 % of the overall value. In other words, any dull color will influence us, regardless of whether it is good or bad. The “O-point” values for each tone were as follows:

Pale: 9 points      Light: 14 points      Bright: 17 points

Vivid: 15 points      Deep: 14 points      Dull: 3 points

Grayish: 11 points.

g) Grayish tone

The overall ratio was 35:38.

This is the only tone with a larger “-” reaction value. It is interesting that young students in their twenties react negatively to this tone which is low in chroma and value.

### 2.3 Conclusions from the O-Ring Color Test

- 1) With the O-ring color test, the influence of color on the body can be measured using our muscular sensor. The influence of any color on a subject can be detected in terms of positive, +/- 0 and negative reactions. It also allows us to confirm the evident influence of colors on the body.
- 2) The subliminal realms of color consist of more hues and brighter colors than those that students choose when designing their environments.



- 3) More than 70 percent of colors to which students showed“+”reactions were their favorite ones. However, this trend is not reflected in their choice of color in the real world, as mentioned above. This tells us that students don't understand the reality of the depth which is made through the interaction of colors and the body in the realm of colors.
- 4) The results of this test with the muscular sensor suggest that color which exercise a good influence on our condition are comparatively bright. but not low in chroma nor in value.
- 5) It can be concluded that the predominance of“+”reactions or“-”reactions is not high in the grayish (adding white to pure color) and pale (adding gray to pure color) color attribute vectors (the third vector is adding black to pure color). These results also indicate that clear colors have a more beneficial influence than dull colors.
- 6) Colors with softer attributes harmonize with the body.

### 3. Measuring Brain Waves under the Color Stimulus

It is not known whether color stimuli exercise an influence on brain waves, because it is impossible to decide whether a change in the brain waves is influenced on hundred percent by color, even when, for example, a one-square-meter piece of blue material is presented in front of a subject. Brain waves are influenced by the subject's color preferences, preconceptions, eyesight, degree of concentration, materials, background color, and so on.

To clarify the relationship between brain waves and color, the condition of the color stimulus must be made as simple as possible. For that purpose, I adopted the idea of measuring brain waves whilst shining stimulus color onto the back of the head, because it is well known that the sensory central nerves are concentrated in the occipital lobe of the brain.

#### 3.1 Brief Explanation of Brain Waves

Almost one hundred years has passed since Hunth Burger, a German physiologist, thought of measuring brain waves through his study of electric eels.

Brain waves are classified as alpha waves ( $\alpha$  waves), beta waves ( $\beta$  waves), theta waves ( $\theta$  waves), delta waves ( $\delta$  waves) and gamma waves ( $\gamma$  waves). Their electrical frequencies are as follows:

$\alpha$  waves (8–13 hertz): Occur during concentration or absorption. Constitute brain waves of man in such conditions as half-wakefulness, light sleep and dozing.

$\beta$  wave (14–32hertz): Brain waves present when man responds to external stimuli, in other words, when fully awake and alert.

$\theta$  waves (4–7 hertz): Mainly observed when man is in deep sleep.

$\delta$  waves (–3 hertz): Observed when man is in coma. 0 hertz indicates brain death.

mid- $\alpha$  waves (9–11hertz): Idea and inspirations are said to occur in this condition.

According to Kazumasa Shiga, head of the Brain Power Development Institute, mid- $\alpha$  waves are closely connected to our ability. The mid- $\alpha$  waves are thought to occur when we are thinking of something creative or original, or when we experience foreboding. When we are working on something and mid- $\alpha$  waves occur, it means that our brain are highly activate and we are in a stable

state of mind.

It is difficult for us to control the frequency of brain waves by ourselves, but external stimuli sometimes induce  $\alpha$  waves. An example of such stimuli is the "1/f fluctuation". Frequencies of the power spectra corresponding to pleasant sounds, such as a gentle breeze or a murmuring brook, fluctuate according to a function of 1/f. Some classical music also follows the 1/f fluctuation. The reason why the head becomes clean and efficiency rises when we work with comfortable sounds of nature or music in the background is that  $\alpha$  waves occur in response to stimuli with the 1/f fluctuation. Our body changes the frequency of the brain waves to the proper stimulus.

### 3.2 Colorde Lights over the Occipital Lobe of the Brain

The aim of this experiment was to observe how brain waves change under color stimuli by placing colored lights on the back of a subject's head. We predicted that the colored lights would directly activate the nerve cells which are concentrated in the sensory region of the brain, and consequently change the brain waves. The purpose of this experiment was not to prove that nervous cells can also sense color, but to observe the influence of color on the brain waves under the least complex conditions available.

This idea of placing colored lights over the occipital lobe was devised when my students and I were experimenting with feeling colors in the dark. A student said that he might be able to feel colors if colored lights were lit behind him, when wearing an eyemask. Four of the seven participants in that experiment felt they could see color clearly in their brains. This therefore gave the idea for this experiment—placing colored lights over the occipital lobe.

An interesting experiment was performed by S. Zeki of the United Kingdom. He studied the reaction of cells taken from the curving sulcus of a red-haired monkey and found that each single cell shows various reactions in response to different colored lights. A certain cell was strongly stimulated by green light and restrained by red light. Many types of cells were found: cells that were stimulated by green and restrained by purple, these stimulated by yellowish green and restrained by purple, these stimulated by red and restrained by bluish green, and many more. In addition, cells which were stimulated by white light alone were found, too. These observations led me to the assumption that man also has color-sensing cells in the sensory center of the occipital lobe like apes. This provided further impetus for this experiment.

### 3.3 Experimental Procedure

#### A) Equipment and subjects

- 1) Electroencephalograph: Neurofax EEG 7310-00305A9 (Nihon Kohden Corporation).
- 2) Positions of electrodes: FP 1 and FP 2 (frontal), F 3 and F 4 (middle-frontal), P 3 and P 4 (middle-occipital), and O 1 and O 2 (occipital).
- 3) Arrangement of equipment (see diagram).
- 4) Spotlight for colored light: incandescent light (200W).

Gelatin filters: red, blue, orange, green, yellow, purple, pink, yellowish green, light blue, deep blue, cream, pale purple (total of 12 colors).

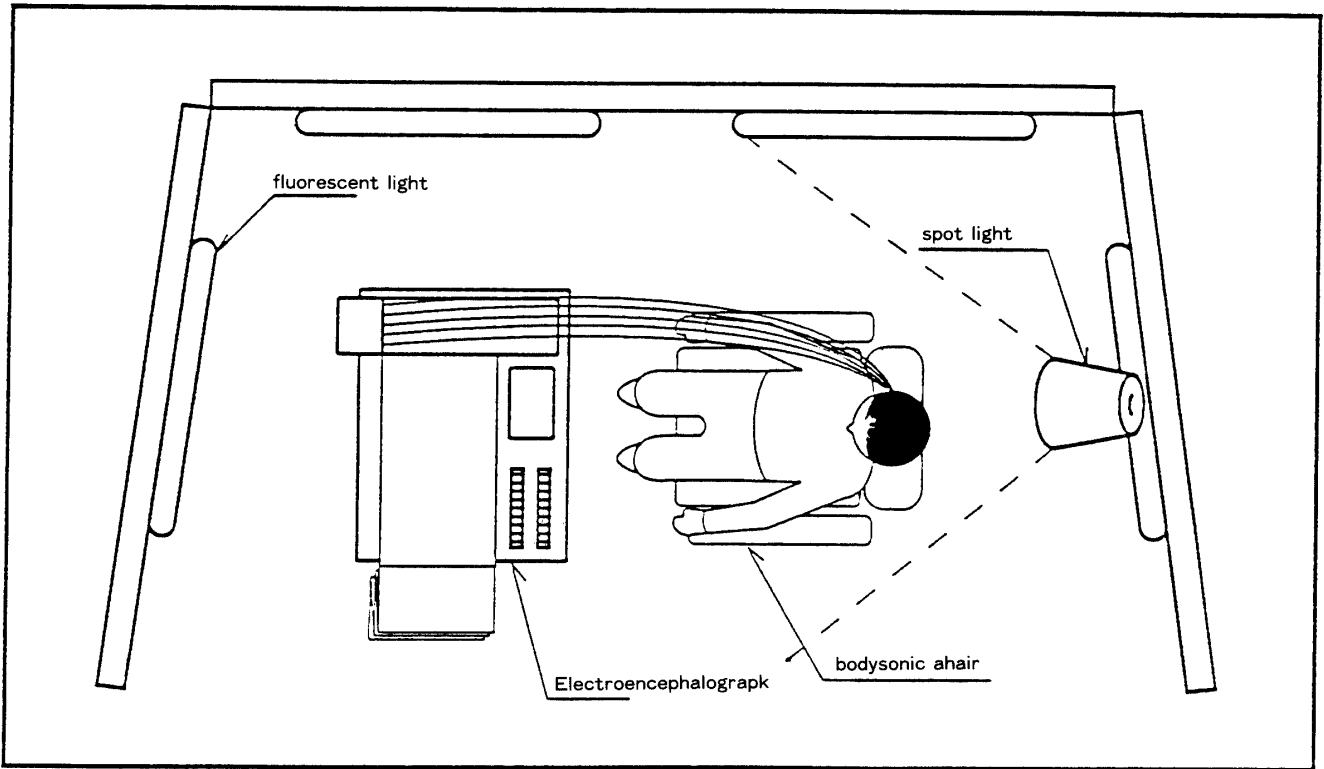


Fig. 2

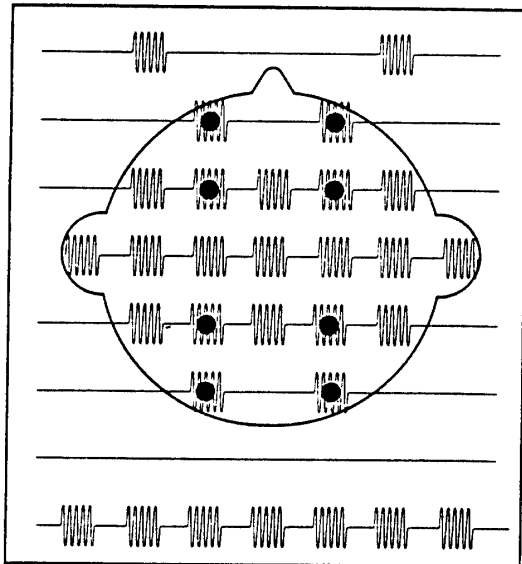


Fig. 3 Positions of elertrodes



measuring brain waves under the color stimulus

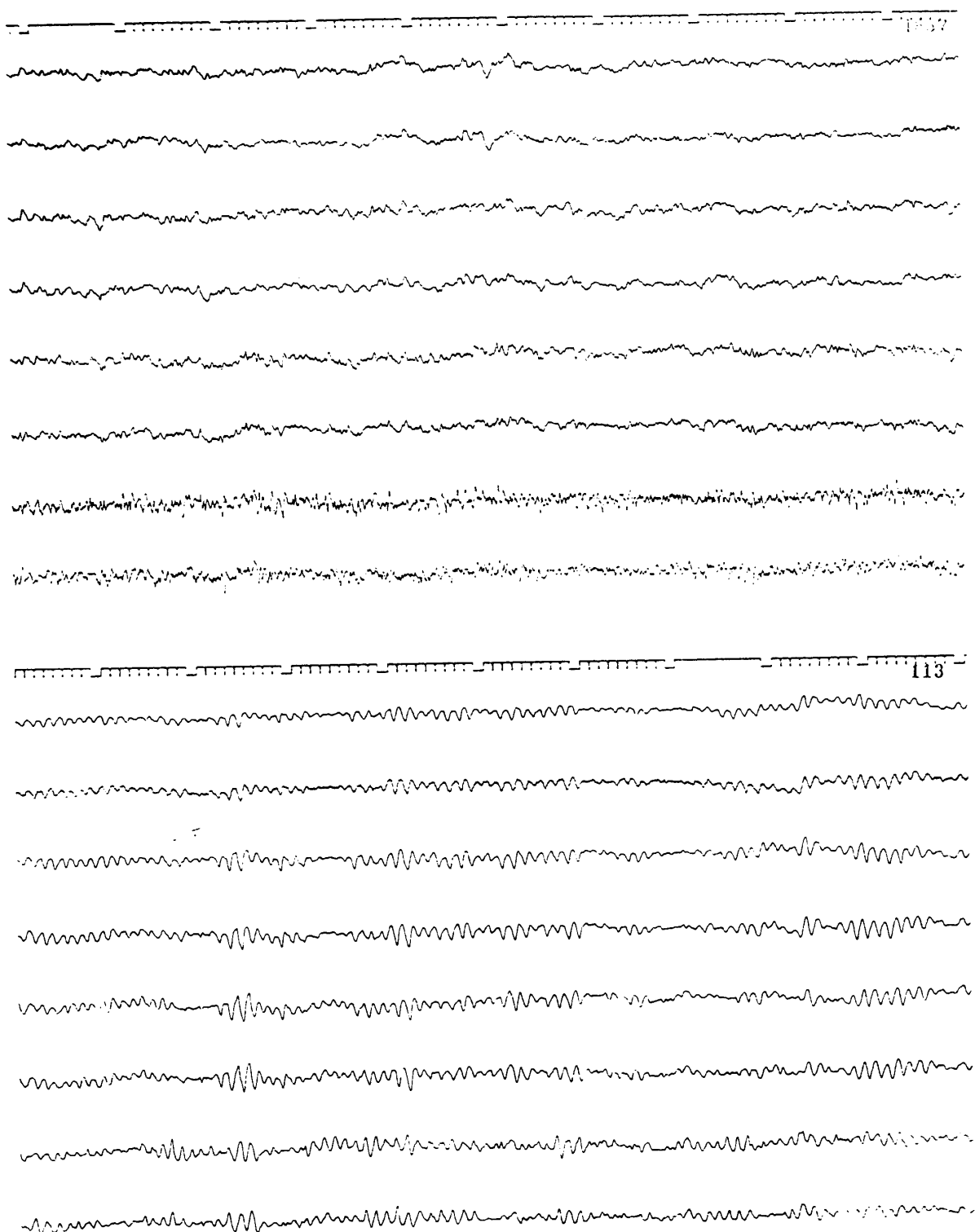


Fig. 4

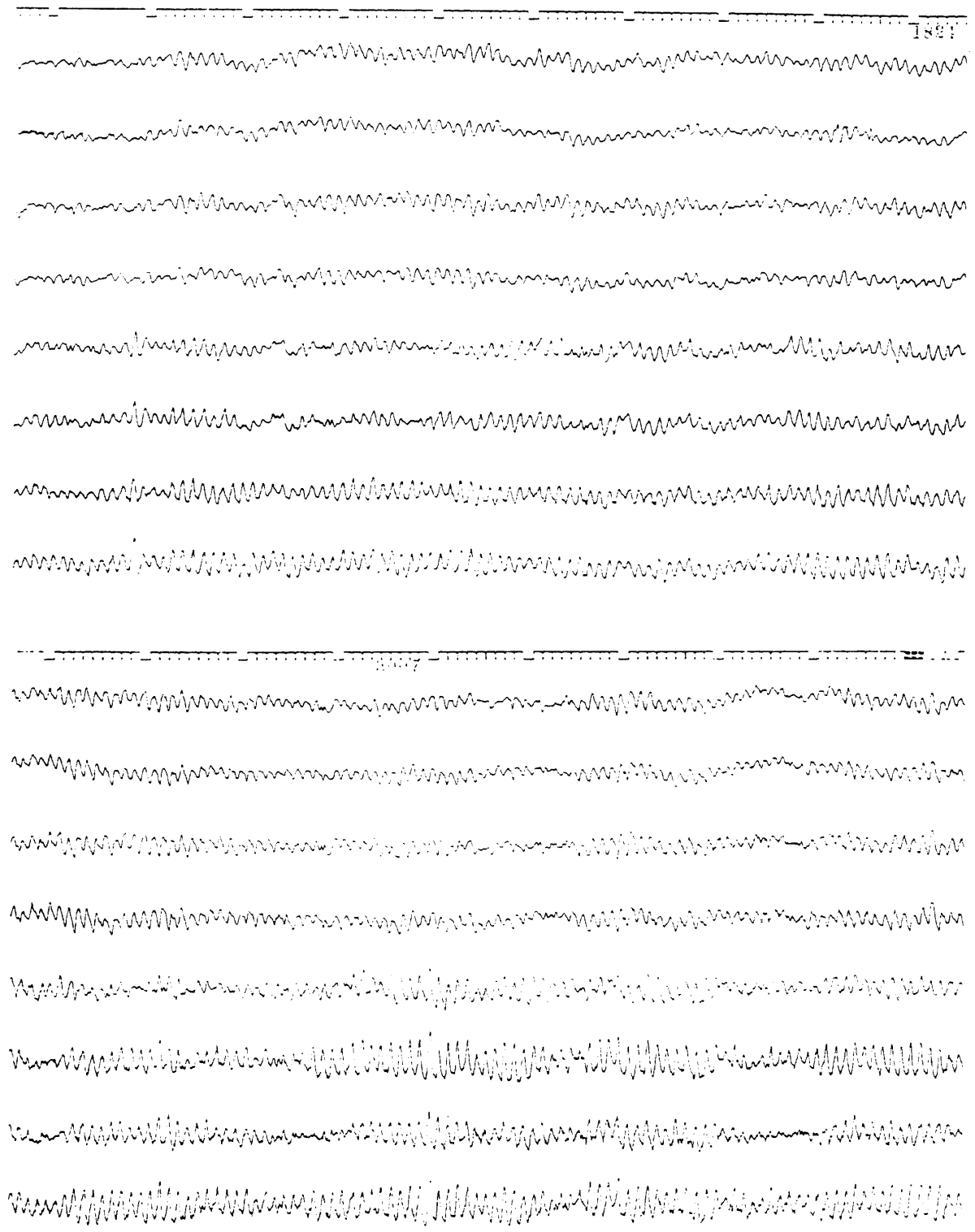


Fig. 4

- 5) Illuminometer: Digital illuminometer (Topcon IM-3).
- 6) Brightness meter: (Topcon EM-8).
- 7) Electroencephalogram analyzer: Hironori Tanaka, assistant professor, Clinic of Psychosomatic Medicine, Kyushu University.
- 8) Subjects: Students of the Faculty of Design, Department of Art, Kyushu Sangyo University (25males and 25females, 50in total).

#### B) Procedure

First, the subject's brain waves were checked under normal conditions for five minutes with the electrodes in position. Then, music was played to relax him. (The music was turned off during the test with the colored lights.) At the start of the test, the room light was turned off and the subject put on an eye mask. Each colored light was lit for four minutes with a one-minute interval for color changes. After six colored light trials, the subject was given a rest for one minute. It took about 65 minutes to finish the entire procedure for one subject.

The positions of electrodes were determined by international standards. One reason for this is the structure of the brain and another is that it enables international comparison and result collation.

At first, we had difficulty carrying out this test because it took too much time to set the electrodes and we were unfamiliar with the electroencephalograph test. It also took some time for the subjects to get used to keeping quiet during the examination. As the test went on, however, we gradually improved until we could carry out the test smoothly.

The graphs shown below are parts of the electroencephalogram of a subject. (A) and (B) show the intermittent occurrence of  $\beta$  waves under red light and  $\alpha$  waves under green light. (C) shows that  $\alpha$  waves start to appear continuously under blue light. (D) shows the transition from  $\alpha$  waves to  $\theta$  waves under purple light.

### 3.4 Results

Before examining the experimental results, I shall briefly outline the relationship between the brain waves and mental physical condition, by referring to the work of Torajiro Ikemi regarding the brain waves of meditators. (T. Ikemi is a professor of Kyushu University who is famous for his study of self-control.)

According to his observations of Zen meditators, the brain waves occur as follows:  $\alpha$  waves occur even though their eyes are open during meditation. Then, their amplitude grows and the cycle lengthens until  $\theta$  waves occur. From a neurophysiological viewpoint, this process indicates a drop in brain activity, that is, a lowering of consciousness. Zen teachers even skip the  $\alpha$  wave state and directly enter the  $\theta$  wave state. In the study of meditation forms including Zen, the consciousness of the  $\alpha$  waves was once regarded as most important, but the  $\theta$  waves have recently revealed a more interesting state of the brain. The  $\theta$  waves usually occur during sleep and also when writers and artists hit upon great ideas.

Table (2) shows the number of occurrences of  $\alpha$  waves and/or  $\theta$  waves in this test. The rates of occurrence were not high, but since none of the subjects had practiced meditation or Zen before, the results seem to indicate an effect of the colored lights.

**Table 2**

	male	female
red	1	0
orang	2	1
yello	1	1
yello-green	0	1
green	3	2
blue	4	3
indigo	2	1
purple	3	3
pink	1	1
beige	0	1
cream	1	0
lightblue	3	2
total	21	16

**Table 3**

color \ brain wave \ sex	$\beta$ wave		$\alpha$ wave		$\theta$ wave	
	male	femal	male	femal	male	femal
red	25	25	14	9	2	0
orange	25	25	15	11	3	2
yellow	25	25	11	12	3	3
yellow-green	25	25	10	18	0	4
green	25	25	7	15	2	5
blue	25	25	16	13	5	3
indigo	25	25	9	7	0	0
purple	25	25	11	15	5	4
pink	25	25	13	12	1	2
beige	25	25	5	9	0	1
creem	25	25	11	6	4	0
lightblue	25	25	9	10	2	3

Table (3) shows by which colors the subjects were most influenced. Influential colors were determined for thirty-seven subjects. Nine of thirteen subjects for whom most influential colors could not determined were female. They did not show obvious tend toward complementary colors, which means they are sensitivity is multiple. These tendencies are thought to be related to physical need because the subjects cannot see the color, and so their color preferences cannot be reflected in the result.

The following observations were made in this test:

- Electroencephlogram(B) clearly indicates the gradual process of dispersion of  $\alpha$  waves from back to front, which means that  $\alpha$  waves at the rear of the head spread across the brain under the color stimulus. (The enhancement of sense may be closely related to peace of mind.)
- The degree of influence on the  $\alpha$  waves and  $\theta$  waves differ noticeably, depending on the subject and hue of colored light.
- During the colored light test, the occurrence of  $\theta$  waves was rare and short-lived.
- The  $\beta$  waves were gradually superseded by  $\alpha$  waves, but not during exposure to the color stimulus.

- Males have a tendency toward complementary colors, whereas females tend toward multiplicity.
- Some subjects recalled the states in which the  $\alpha$  waves or  $\theta$  waves occurred and have since become able to consciously bring themselves to the same state.
- Cold colors arouse the  $\alpha$  and  $\theta$  waves better than other colors.

#### 4. “Self-Care-Color”

I once compared the tendencies of students when arranging colors with their character test results and found a mental process in choosing certain colors, although they seemed to be chosen at random. In addition to this finding, the fact that about seventy percent of “+” reactions for the O-ring test correspond to the favorite colors of the student leads us to conclude that each person should have certain colors that satisfy conscious as well as subconscious needs.

Next, I shall describe the colors that induce “+” reactions as “Self-Care-Colors”. There were some cases of a strong “+” reaction to a special color and others where these were similar “+” reactions to several colors. I have called the former a “Theme Color” and the latter “+ colors”.

Through the O-ring and brain-wave tests, students found their own “Self-Care-Colors”, and were impressed with the overall results of the tests. I, thus, gave them a couple of exercises in color arrangement using their “Self-Care-Colors” to see how the discovery of their “Self-Care-Colors” influenced them.

##### 4.1 Exercises in “Self-Care-Color” Arrangement

###### 1) First exercise

Subject: Harmonization of “Self-Care-Colors”

Conditions:

- Each student was made to arrange sixteen 4 x 4 cm squares of colored paper, to make a 16x16 cm square.
- Theme Colors and “+” Colors should make up between eighty and one hundred percent of the finished square. Only when harmony would not be obtained, could other colors be used.

Notes:

- (1) Identical colors cannot be positioned adjacently.
- (2) Harmony takes first priority.
- (3) The time limit is eighty minutes.
- (4) The edges of the paper must be sharp.
- (5) Colored paper must be neatly mounted.

###### 2) Second exercise

Subject: Empathic development of “Self-Care-Colors”

Conditions:

- Draw pictures that express the following image terms\*: a) sweet, b) speedy, c) heavy, d) young, e) sour, f) high-grade, g) feminine, h) autumn, i) healthy, and j) anger.

\*Image terms differ slightly in some classes.



- Each work should be abstract and geometrical, drawn with empathic structure in a 5 x 5 cmsquare.
- Theme Colors and“+Colors”must make up more than fifty percent of each woke.
- Poster colors must be used for painting.

### 3) Orientation regarding empathic development

The following is a summary of the detailed explanation that I gave students regarding“empathic development”.

- a) The empathic sense that is typical for those who can“hear”color is closely related to creativity, as seen in the“vowels”of Arthur Rimbaud, an empathic poet.
- b) The empathic sense becomes universal in such phrases as“yellow scream”and“red passion”, where it is known as “modal usage”.
- c) Modal usage promotes an ability to capture the features of objects in an instant.
- d) We have this ability as a latent sense deep in our body and soul, and the sense itself is observed only through the“+”colors of the O-ring test.

## 4. 2 Evaluation

- Male, 21 years old:

### 1) First exercise

- :  $\alpha$  wave promoting color
- ◻ :  $\alpha$  wave and“+ 2 ”-reaction color
- △ :  $\alpha$  wave and“+ 1 ”-reaction color
- △ : “+ 2 ”-reaction color
- : “+ 1 ”-reaction color
- none : O-point color

## 4. 3 Results

The students completed questionnaires about the tests and exercises they underbook.

The following are some of their impressions:

- I didn’t think that color arrangement could be such great fun.
- I thought I was weak at handling color, but now I can do it with confidence>
- I was excited because I thought I had created my best works ever until I saw the great work of the others and remembered there can always be something better.
- I found myself doing these exercises very seriously, which is something I have not experienced with previous assignments.
- I found out what I am good at and what I am bad at.
- I didn’t waver when choosing colors.
- It is unbelievable that several“Self-Care-Colors”can harmonizé so well.
- It’s great that“Self-Care-Colors”are not boring to use, but I do feel uneasy when I try other colors.

- I was very inspired by the works of the others.
- I experienced increased concentration when working on the assignment.
- I feel I could try to express any image terms.
- The level of the whole class rose.
- I learnt a little about the relationship between color and me.
- The work of the whole class looks similar.
- My work was the best.

The following points were clear from the students' remarks and art works:

- Interest in color has apparently deepened and the level of the class has risen.
- Internal factors for expression have been strengthened and confidence in using color has grown.
- After the discovery of "Self-Care-Color", interest in color has changed with regard to clothing, walls and other aspects of everyday life.
- The students have begun to perform the O-ring test for various things, which indicates that they have become more flexible in considering their empathic sense.
- They have become more interested in each other's work.
- Their character is a driving power when creating unique work.

Matters to be solved:

- More data is needed.
- Check O-ring test and brain-wave test with multiple color stimuli.
- The creation of exercises that match the amount of time and effort spent on the experiments.
- The discovery of "Self-Care-Color" is important, but it is just a trigger for realizing fertile and versatile expression.

## 6. Conclusion

The aim of this study was to find an alternative method to enable students to understand their close relationship with the sphere of color, in other words, to establish their identity in color arrangement. To my satisfaction, thanks to the O-ring test and brain wave test, students notice the existence of "Self-Care-Color" and were impressed by the discovery of the color that they subconsciously desired to use with confidence.

The "Self-Care-Color" has changed the quality of the students' trial-and-error arrangement of color, and they now like doing it. The participants were interested and devoted much time, even after school hours, to the study.

I am planning to continue this study to develop a color arrangement system with a simpler procedure, with the aim of increasing the student's confidence.

I would like to thank to Hironori Tanaka of Kyushu University for his invaluable advice and for taking the trouble to analyze the electroencephalograms. I would also like to thank to Yasunobu Suzuki, my colleague, for his great assistance in conducting the experiments.

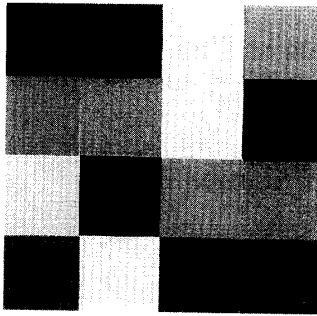
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● Male, 21 years old:

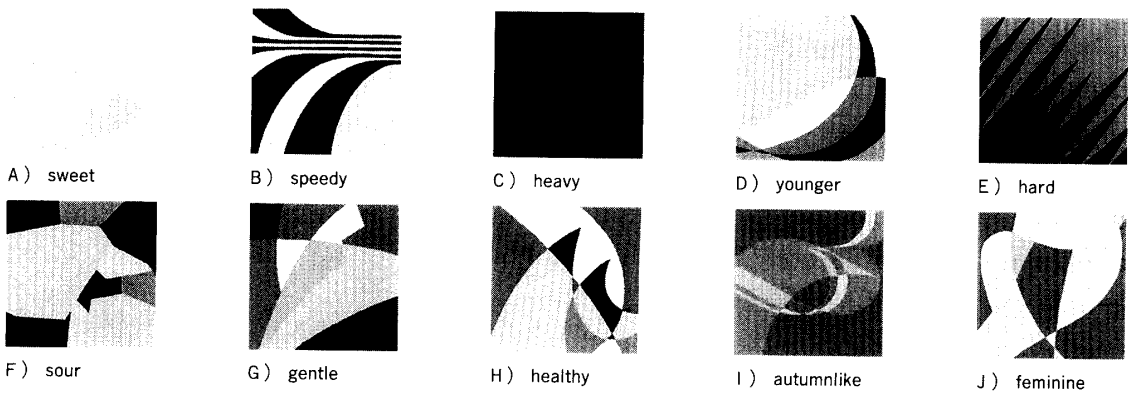


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△	□	□	○
□	□	△	□
□	○	□	△

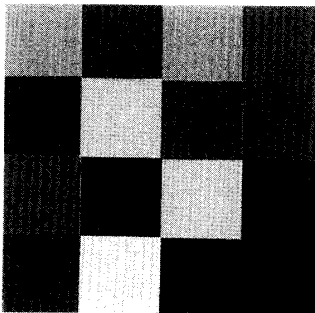
- 1) First exercise
- : α wave promoting color
  - : α wave and " + 2 " -reaction color
  - △ : α wave and " + 1 " -reaction color
  - △ : " + 2 " -reaction color
  - : " + 1 " -reaction color
  - none : 0-point color

2) Second exercise

His attitude to form is clear and manly, bold yet fine. Shapes are well-calculated. He has more ability for construction than for empathy. His excellent sense of color enables his "Self-Care-Colors" to match one another.



● Male, 18 years old:

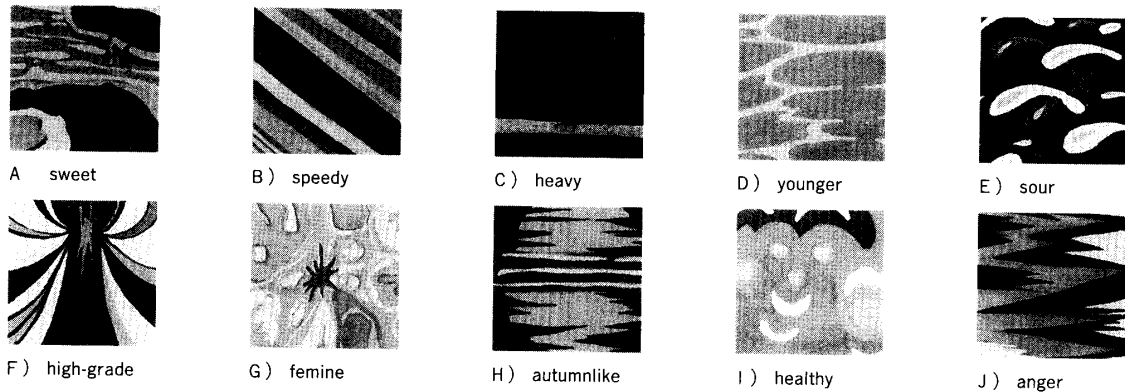


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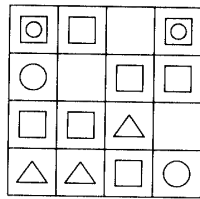
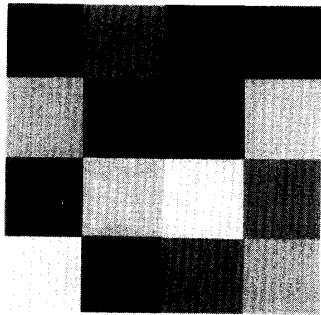
1) First exercise

2) Second exercise

Red and green are the main colors in general. His sense can be described as being of the sense-of-touch type. He prefers curves and uses colors with the same value unaffectedly.



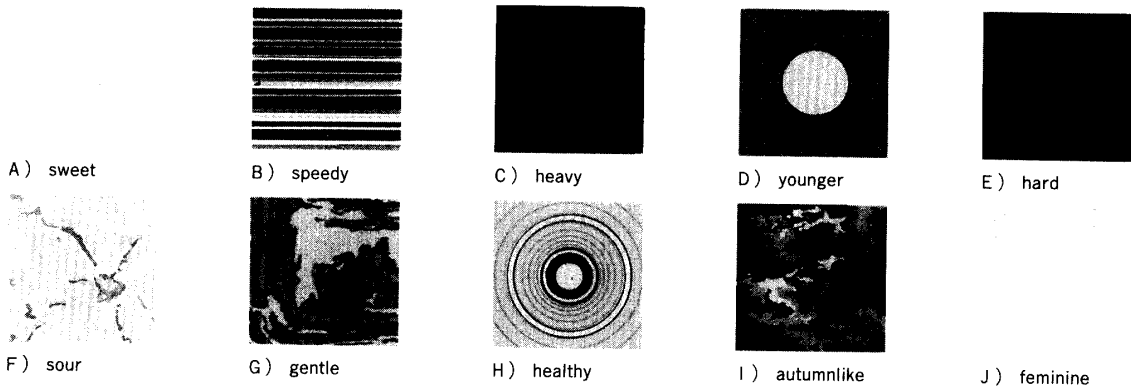
● Female, 18 years old:



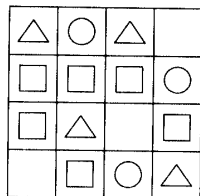
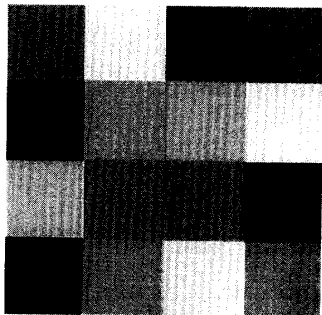
1) First exercise

2) Second exercise

She scores the highest level of empathy and succeeds in making use of her "Self-Care-Color", expressing organic beauty in a lively manner >



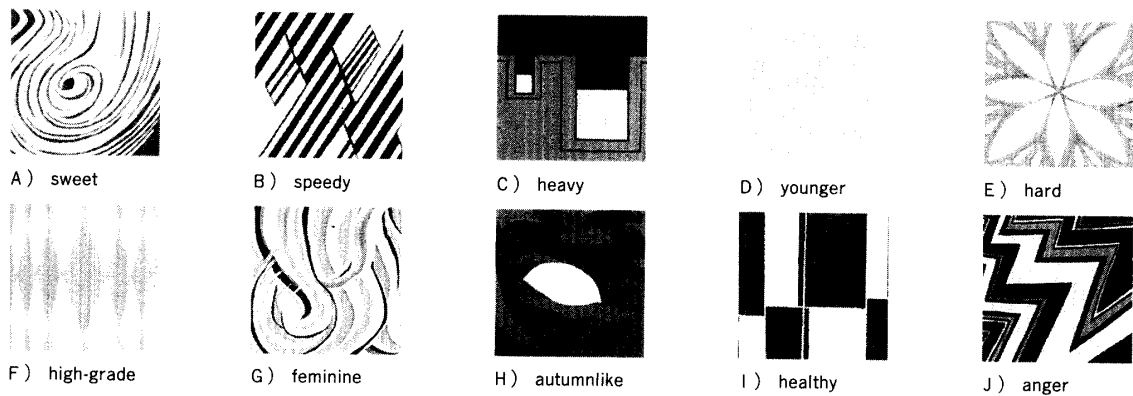
● Male, 19 years old:



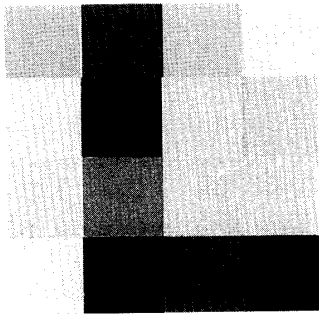
1) First exercise

2) Second exercise

Yellow, his  $\alpha$  wave promoting color, is beautiful in each work. Empathic adjustment is excellent. The complementary combination of yellow and blue forms the basic color. Thanks to his fine adjustment of tones, other relatively difficult colors match well. Rather feminine among men.



● Male, 20 years old:

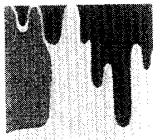


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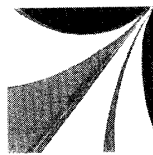
1) First exercise

2) Second exercise

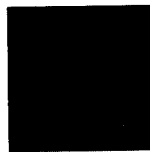
He is unrivaled in structuring, shape orientation, and has a good sense of color. Those who prefer from are usually weak in empathic expression, but he is an expection.



A) sweet



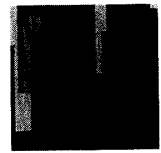
B) speedy



C) heavy



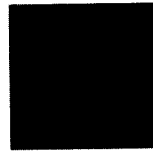
D) younger



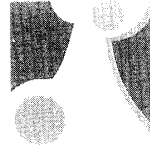
E) hard



F) sour



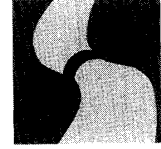
G) gentle



H) healthy

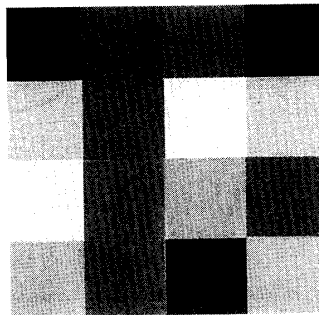


I) autumnlike



J) feminine

● Female, 20 years old:



□	○	□	□
□	△	△	□
△	□	○	△
○	□	□	△

1) First exercise

2) Second exercise

The coloring deviates slightly from her "Self-Care-Color", but her way of forming is unpredictably distinctive and the essence of her own color is skillfully expressed. Empathic reaction is dynamic and her imagination is fertile.



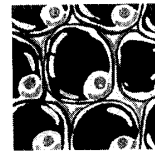
A) sweet



B) speedy



C) heavy



D) younger



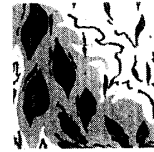
E) sour



F) high-grade



G) feminine



H) autumnlike

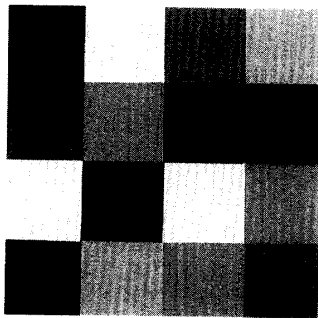


I) healthy



J) anger

● Female, 19 years old:



○	△	△	□
□	△		○
△	○	△	△
	□	△	□

1) First exercise

2) Second exercise

The handling of form and color is organic and original, which indicates the depth of empathy through positive reaction colors.



A) sweet



B) far



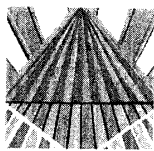
C) heavy



D) younger



E) sour



F) high-grade



G) feminine



H) autumnlike

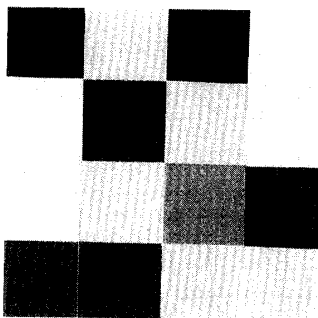


I) healthy



J) anger

● Female, 20 years old:



□	△		△
□	○	□	□
△	△	□	○
○	□		△

1) First exercise

2) Second exercise

The complementary combination of yellow and blue is her basic "Self-Care-Color". However, she uses multiple colors. Her sense of color is excellent and she knows how to use "her own" colors.



A) sweet



B) speedy



C) heavy



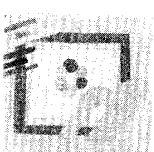
D) younger



E) sour



F) high-grade



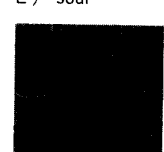
G) feminine



H) autumnlike

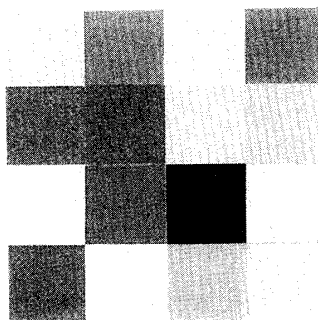


I) healthy



J) anger

● Male, 19 years old:



△	□	△	□
	△	△	△
○	□		○
△	□	△	□

1) First exercise

2) Second exercise

He prefers feminine color. The reason why he uses vivid color more in this exercise than in the first may be that he has a fertile empathic imagination.



A) sweet



B) speedy



C) heavy



D) younger



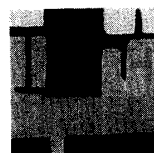
E) sour



F) high-grade



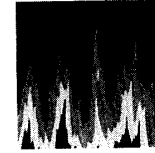
G) feminine



H) autumnlike

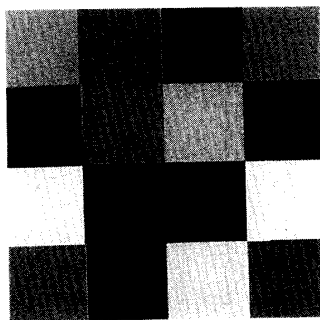


I) healthy



J) anger

● Female, 19 years old:



△		△	□
△	□	△	△
△	□	□	△
□	□	□	

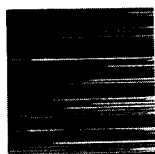
1) First exercise

2) Second exercise

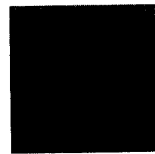
It can be seen that her fertile imagination stems from her "Self-Care-Color", which is used as the basis for harmony.



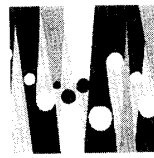
A) sweet



B) speedy



C) heavy



D) younger



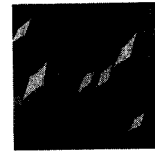
E) sour



F) high-grade



G) feminine



H) autumnlike



I) healthy



J) anger