

異なった形および運動をともなう色のイメージ

三 星 宗 雄

キーワード：色、色彩、イメージ、形、運動、SD 法

要 約

さまざまな色のウェアで身を包んだダンサーが直線状に移動する時と、曲線を描いて移動する時の、観客が抱くイメージは異なるに違いない。F1 カーレースなども同じであろう。色に対するイメージはこれまで多くの研究がなされてきた。その中には色と形との相互作用を検討したものもあるが、運動を伴う研究は見当たらない。本研究ではさまざまな形および運動状態における色のイメージを7ポイント、21尺度から成るSD法を用いて測定した。

刺激の色は赤、青、緑の3種類、形は円、正三角形、正方形の3種類、運動は静止、円環、垂直、水平の4種類であった。それらの刺激はマイクロソフト社のパワーポイントを用いて作成され、PC-プロジェクションシステムを用いてランダムな順番でスクリーンに提示された。実験参加者として25名の大学生が参加した。

その結果以下のことが明らかになった。

(1) 色のイメージはその形および運動によって異なり、場合によっては逆転した。(2) 赤は形および運動によって影響を受けにくく、一方緑は変化しやすい。(3) 運動がない場合、円形は色によってイメージが変わりやすく、一方三角形は色のイメージが安定していた。(4) しかしいったん運動を伴うと、三角形と四角形は色によってイメージが変化しやすく、逆に円形の色イメージは安定的であった。(5) 円環運動している時の色のイメージは静止状態とあまり変わらず、一方垂直運動は最も大きな影響を及ぼした。(6) 個々のイメージでは「柔

「らかい-かたい」が形によって、また「賑やかな-寂しい」と「単調な-変化のある」が運動の影響を受けやすかった。

最後にこれらの結果は運動を伴う web サイトの制作などで活用できる可能性が示唆された。

The image of color with different shapes and in different motions

MITSUBOSHI Muneo

Key words: color, image, shape, motion, SD

Abstract

A color stimulus (red, green or blue) of different shapes (circle, triangle or square) was presented on the screen in different motions of circular, vertical and horizontal, or steadily (without motion). The images were evaluated with 7-point SD scales with the participation of twenty-five subjects.

The main results are as follows: (1) the image of color considerably changed both due to shape and motion. Sometimes it completely reversed. (2) The image of green easily changed generally both due to shape and motion. (3) The image of red, on the contrary, was least affected both due to shape and motion. (4) The image of color was most affected for the shape of \bigcirc when it did not move, and was least affected for \triangle . (5) When the motion was introduced, the color image of \triangle and \square turned to be most changeable, and that of \bigcirc least. (6) The circular motion did not affect much the image of color, and the vertical one did much. (7) The image of “soft - hard” was most changeable due to shape and the images of “thick-plain” and “monotonous-changeable” were most affected due to motion.

INTRODUCTION

It appears that the movements of dancers wearing in

different colors give us different images when they move straight or move around. Also we feel different images when the F1 racing cars of different colors run straight or when they come around in the corners. Many studies have been done so far on the images of colors (Oyama et al., 1965, Isogai et al., 1974; Natori, 1993; Mitsuboshi, 2008). Some of them were conducted to explore the interactive effects in the image between the shape and the color. Tomita et al. (1968) showed that the colors of red, orange, blue and especially purple were less affected by their shape, and that the colors of green and yellow were more affected by their shape. Ohmi et al. (1971) showed that the geometrical figures tended to change their image by their colors and less affected were the figures having names and least were the meaningless figures.

But none of them were studied in different motions. The motion is quite a strong cue for the animal to find out a target in the environment. It is, therefore, possible that the image of a color could change by their motion, as well as by their shape. Such effect of the motion seems quite important for, e.g. web designing with motions.

The aim of the present paper is to explore how the image of colors do change due to shape and motion using SD method.

Method

Apparatus and Stimulus:

Color stimuli were presented on a screen via a computer-projection system. The luminance (cd/m^2) and the chromaticity coordinates (CIE x , y coordinates) were (65.3, .53, .366) for the red stimulus, (110, .191, .239) for the blue one and (210, .268, .539) for the green one. The luminance and the CIE x , y coordinates of the screen off the stimulus were (334, .285, .392). The average horizontal illuminance (lx) and the chromaticity coordinates (CIE x , y coordinates) during the stimulus was on

the screen was (46.3, .330, .389) for the nearest seat to the screen and (39.6, .336, .376) for the farthest seat.

The nearest and the farthest seats were about 3m and 5m away from the screen respectively forming the visual angles of the stimuli in 3.42° for the diameter of the circle and a side of the equilateral triangle, and 3.14° for the square. The visual angles of these stimuli at 5m were 2.05° and 1.88° respectively.

The distances of the motion were 16.15° (9.69°) in visual angle for the diameter of the circular motion at 3m (5m), 15.2° (9.12°) for the vertical and 22.8° (13.68°) for the horizontal motions respectively.

The temporal condition of the stimulus was controlled by the Power-Point System of Microsoft Co. Ltd. after preliminary experiments. When the speed of motion of the stimulus was slow, the image was formed solely by their color irrespective of their motions. The speed of motion of the stimulus, therefore, should have been set for their image to be affected by both color and motion. Eventually the speed of motion turned to be at the maximum, i.e. 1 back-and-forth in 1 second for the horizontal and vertical motions and 1 rotation in circular locus in 1 second.

Three colors, red, green and blue were examined in three different shapes, circle, triangle and square, in four motions, circular, vertical, horizontal and steady, i.e. without motion. Each of those 36 patterns of stimuli were presented at random.

Participants:

In total of 25 participants were recruited. All of them were students of Kanagawa University at ages ranging from 18 to 21. The experiments were conducted in their classes and so were not paid.

SD scales:

Fig.1 shows the SD scales used, where Japanese was added in each scale for exact comparison.

- | | |
|---------------------------|----------------|
| 1. like - dislike | (好き-きらい) |
| 2. soft - hard | (柔らかい-かたい) |
| 3. thick -plain | (賑やかな-寂しい) |
| 4. elegant - vulgar | (上品な-下品な) |
| 5. monotonous - changeful | (単調な-変化のある) |
| 6. heavy - light | (重い-軽い) |
| 7. dynamic - static | (迫力がある-迫力がない) |
| 8. simple - tedious | (あっさりした-くどい) |
| 9. romantic - realistic | (ロマンチックな-現実的な) |
| 10. modern - ancient | (現代的な-古ぼけた) |
| 11. natural - unnatural | (自然な-不自然な) |
| 12. beautiful - ugly | (美しい-きたない) |

Fig. 1 SD scales used. Japanese are added for exact comparison.

Procedure

The participants evaluated the image of the color in different shape and motion using 12 SD scales with 7 points (See Fig. 1). Each stimulus was on the screen until all the participants completed the SD sheet for that stimulus. The circular motion was repeated on the same site and the horizontal and vertical motions were repeated back-and-forth. Almost one hour was needed to complete the experiment.

Results

Definition:

#1 The effect of shape :

When the sign of the point for an image (a SD scale, e.g. 2 (“soft-hard” scale) reversed for a shape for all four motions including the steady (motionless) condition, it was that there was recognized the effect of shape.

#2 No effect of shape (“Unchangeability”) :

When the sign of the point for an image (a SD scale, e.g. 2 (“soft-hard” scale) was same between two or among three shapes for all four motions including the steady (motionless) condition, it was that there was no effect of shape.

#3 The effect of motion :

When the sign of the point for an image (a SD scale, e.g. 2 (“soft-hard” scale) for a kind of motion reversed from that for the steady (motionless) condition through all three shapes, it was that there was recognized the effect of motion.

#4 No effect of motion (“Unchangeability”) :

When the sign of the point for an image (a SD scale, e.g. 2 (“soft-hard” scale) in the steady (motionless) condition was same as one of other three motions for all the shapes, it was that there was no effect of motion.

The results were summarized in Tables 1 to 9 for different combinations of color and shape. ○, △ and □ indicates the shapes of the stimulus and S, C, V, H do Steady (without motion), circular, vertical and horizontal motion respectively.

Table 1 shows the average evaluating points for each scale for the red ○ stimulus. The negative signs mean the higher evaluation towards the right hand in each scale.

The image of the scale 1. “like-dislike”, for the steady red ○ stimulus reversed when it moved in circular and horizontal ways. On the other hand the image of the scales 2, 3, 7, 8, 9, 10 and 12 did not change from the steady one whatever motion was introduced.

Table 3 is the results for the green ○, where the image of 3. “thick - plain”, reversed from the steady condition when whatever motion was introduced. That means the image of green ○ was “plain” when it was shown steadily, but it turned into “thick” by any kinds of motions.

Table 1 Average evaluation points in each motion for red ○

○ : shape of circle, S: Steady, C: Circular, V: Vertical, H: Horizontal

SD scale	Motion			
	S	C	V	H
1	0.71	0.5	-0.07	-0.14
2	0	0.57	0.71	0.43
3	0.71	1.36	2.14	1
4	0.5	0	0.07	-0.14
5	1.5	0.43	-1.14	0
6	0.71	0.21	-0.21	0.5
7	0.86	0.79	1.57	0.79
8	-0.21	-0.21	-1.14	-0.57
9	0	0.21	0.29	0.43
10	0.93	0.57	0.71	0.29
11	0.57	0.14	-0.79	0.14
12	1.43	0.21	0.36	0.21

Table 2 Average evaluation points in each motion for blue ○

SD scale	Motion			
	S	C	V	H
1	1.21	0.21	0.36	0.5
2	0.43	1.14	0.71	0.29
3	-1.07	-0.36	1.07	0.14
4	0.43	0.57	0.5	0.29
5	2.07	0.07	-0.36	0.07
6	-0.71	-0.29	-0.36	-0.43
7	-1.14	-1.07	0.57	-0.21
8	2	0.79	0.36	0.86
9	-0.86	-0.29	0.07	-0.64
10	0.86	0.36	0.79	0.86
11	0.5	0.86	0.71	0.14
12	0.71	0.57	0.71	0.57

Table 3 Average evaluation points in each motion for green ○

SD scale	Motion			
	S	C	V	H
1	0.71	0.93	-0.07	0.64
2	1.36	1.5	1.21	1.29
3	-0.64	0.07	1.79	0.57
4	0.64	0.86	-0.07	0.29
5	1.57	0.64	-1	0.43
6	-1	-1.43	-1.57	-1.14
7	-1.43	-1.43	0.93	-1
8	1.64	0.93	0.64	1
9	-0.43	0.07	0.29	-0.07
10	0.21	-0.14	0.64	0.36
11	1.36	1.36	0.07	1
12	1.14	1.07	0.5	0.86

Table 4 Average evaluation points in each motion for red △

SD scale	Motion			
	S	C	V	H
1	-0.07	0.36	-1	-0.5
2	-1.21	-0.71	-0.71	-0.79
3	0.14	0.43	1.79	1.07
4	0	-0.57	-0.57	-0.57
5	1.36	0.14	-1.36	-0.29
6	0.86	0.5	0.21	0.21
7	0.71	0.07	1.29	0.71
8	-0.5	-0.43	-1.71	-0.57
9	0.07	-0.14	-0.71	0.14
10	0.07	0.64	0.71	0.43
11	-0.07	-0.5	-1.5	-0.36
12	-0.07	0.29	-0.64	-0.14

Table 5 Average evaluation points in each motion for blue \triangle

SD scale	Motion			
	S	C	V	H
1	0.14	0.07	-0.43	-0.14
2	-0.92	-0.79	-1.29	-0.79
3	-1.43	0.07	0.71	0.29
4	0.57	-0.36	-0.64	-0.07
5	2.21	-0.07	-0.86	0.36
6	-0.14	-0.5	-0.79	-0.36
7	-1.21	-0.07	0.86	-0.43
8	1.86	0.64	0	0.14
9	-1.07	-0.79	-0.07	-0.79
10	0.57	0.21	0.14	0.43
11	0.36	-0.57	-0.93	-0.5
12	0.57	0.29	-0.29	-0.07

Table 6 Average evaluation points in each motion for green \triangle

SD scale	Motion			
	S	C	V	H
1	0.5	-0.21	-0.57	0
2	-0.36	-1	-0.14	-0.14
3	-1	0.64	1.21	1
4	0.36	-0.29	-0.5	-0.07
5	2.14	-0.5	-0.57	-0.43
6	-1.21	-1.36	-1.21	-1.29
7	-1.93	-0.29	0.5	-0.36
8	1.29	0.71	-0.36	1.14
9	-0.29	-1.14	-0.43	-0.64
10	0.43	1	0.57	0.57
11	1.14	0.21	-0.36	0.21
12	0.93	-0.07	-0.29	0.5

Table 7 Average evaluation points in each motion for red \square

SD scale	Motion			
	S	C	V	H
1	0.07	0.21	-1.07	-0.07
2	-1.36	-0.43	-1	-1.07
3	-0.36	0.86	1.79	1.79
4	-0.07	0.21	-0.5	-0.79
5	1.57	0.29	-0.86	-1.5
6	1.29	0.5	0.71	0.93
7	0.79	-0.07	1.79	1.29
8	-0.79	-0.29	-1.14	-0.93
9	-0.29	-0.29	0	-0.57
10	0.36	0.14	0.5	0.36
11	-0.5	-0.57	-1.21	-0.93
12	0	0.14	-0.86	-0.21

Table 8 Average evaluation points in each motion for blue \square

SD scale	Motion			
	S	C	V	H
1	0.5	0.36	-1.14	-0.29
2	-0.79	-0.14	-0.36	-0.43
3	-1.29	-0.64	1.43	0.43
4	0.79	0.5	-0.57	0
5	2.21	0.14	-1.14	-0.57
6	0.07	0.07	-0.93	-0.36
7	-1.21	-0.93	1.29	-0.29
8	1.64	1.21	-0.86	0
9	-0.79	-0.64	-1.29	-0.71
10	0.43	-0.07	0.14	0.07
11	0.36	0.57	-1.64	-0.86
12	1	0.64	-0.79	-0.14

Table 9 Average evaluation points in each motion for green \square

SD scale	Motion			
	S	C	V	H
1	0.71	0.5	-0.29	-0.36
2	-0.21	0.86	0.36	0
3	-0.86	-0.07	1.14	1.57
4	0.36	0.21	-0.14	-0.57
5	1.71	0.57	-0.71	-1.14
6	-0.21	-1.29	-1.43	-1.71
7	-1	-1.5	-0.29	0.14
8	1.36	1.36	0.71	0.21
9	-0.57	-0.64	-0.36	-0.86
10	0.29	0.43	0.36	1.07
11	0.93	0.86	0.21	0.36
12	1	0.57	-0.14	-0.21

The following are the summary of the results in terms of the reverse or non-reverse in image due to shape and motion.

A. Shape

1. Red

(1) the image (SD scale) which showed reverse due to shape for all four kinds of motion by *Definition #1*.

2. $\bigcirc \Leftrightarrow \triangle, \square$

(2) images (SD scales) which showed no reverse due to shape for all four kinds of motion by *Definition 2*.

1. $\bigcirc = \square$

2. $\triangle = \square$

3. $\bigcirc = \triangle$

5. $\triangle = \square$

6. $\triangle = \square$

7. $\bigcirc = \triangle$

8. $\bigcirc = \triangle = \square$
9. $\bigcirc = \square$
10. $\bigcirc = \triangle = \square$
11. $\triangle = \square$

2. Blue

(1) the image (SD scale) which showed reverse due to shape by *Definition #1*.

2. $\bigcirc \Leftrightarrow \triangle, \square$

(2) images (SD scales) which showed no reverse due to shape by *Definition #2*.

1. $\triangle = \square$
2. $\triangle = \square$
3. $\bigcirc = \square$
6. $\bigcirc = \triangle$
7. $\bigcirc = \triangle = \square$
8. $\bigcirc = \triangle$
9. $\triangle = \square$
10. $\bigcirc = \triangle$
12. $\triangle = \square$

3. Green

(1) the image (SD scale) which showed reverse due to shape by *Definition #1*. None

(2) images (SD scales) which showed no reverse due to shape by *Definition #2*

3. $\bigcirc = \triangle$
6. $\bigcirc = \triangle = \square$
7. $\bigcirc = \triangle$
8. $\bigcirc = \square$
9. $\triangle = \square$
10. $\triangle = \square$
11. $\bigcirc = \square$

Table 10 “Unchangeability” of image
(See *Definition #2*.)

Color	Shape			Total
	○	△	□	
red	6	8	8	22
blue	5	8	6	19
green	5	5	5	15
Total	16	21	19	

The images which showed reverse due to shape were 2 (“soft-hard”) between red and blue ○ and △ or □ for all four kinds of motion . The images of “soft-hard” for red and blue stimuli were “soft” for ○, but shifted into “hard” when it was of the shape of △ or □. The image of “soft-hard”, however, did not change between △ and □.

The image of 2 (“soft-hard”) for green was “soft” for ○ in all four kinds of motion, and “hard” for △ in all four kinds of motion. But whether the image was “soft” or “hard” depended on the kind of motion for green □. It can be said that the existence of corners in a figure generally strengthened the image of “hard”.

On the other hand, the images of 8 (“simple - tedious”) and 10 (“modern-ancient”) for red, 7 (“dynamic-static”) for blue, and 6 (“heavy-light”) for green did not change irrespective of their shape.

The numbers of 16 for ○, 21 for △ and 19 for □ in Table 10 are considered to be a kind of measure of “unchangeability” of image of the shape by its color. The image of the shape of triangle is least changeable by color, and the image of the circle most.

The number of 22 for red, 19 for blue and 15 for green in Table 10 are considered to be a kind of measure of “unchangeability” of image of color by its shape (See *Definition #2*). The image of red is least changeable due to shape, and the

image of green most.

B. Motion

1. Red

(1) images (SD scales) which showed reverse between the steady (motionless) and any other three kinds of motion conditions by *Definition #3*.

5. V

(2) images (SD scales) which showed no reverse between steady (motionless) and any other three kinds of motion conditions by *Definition #4*.

2. C, V, H

5. C

6. C

8. C, V, H

10. C, V, H

11. C

12. H

2. Blue

(1) images (SD scales) which showed reverse between steady (motionless) and any other three kinds of motion conditions by *Definition #3*.

3. V, H

5. V

7. V

(2) images (SD scales) which showed no reverse between steady (motionless) and any other three kinds of motion conditions by *Definition #4*.

1. C

2. C, V, H

6. C

7. C, H

8. C, H

9. C, H
10. V, H
11. C

3. Green

(1) images (SD scales) which showed reverse between steady (motionless) and any other three kinds of motion conditions by *Definition #3*.

1. V
3. V, H
4. V
5. V

(2) images (SD scales) which showed no reverse between steady (motionless) and any other three kinds of motion conditions by *Definition #4*.

6. C, V, H
7. C
8. C
9. H
10. V
11. C, H

Table 11 shows the cases in which the image of the steady color reversed when it was presented in any of three motions. It should be pointed out that the digits inside the matrix show the numbers of SD scales reversed. It is clear that the vertical motion does change much the image of color and the circular one have no effect on it and that the red color seems to resist motion in image.

Also the images of 3 (“thick-plain”), 5 (“monotonous - changeful”) and 7 (“dynamic-static”) were easy to change due to motion. The images of “plain” and “monotonous” turned to be “thick” and “changeful” respectively when any of three motions was introduced.

Table 11 Reverse of image due to motion (The digits inside the matrix are the numbers of SD scale. See text for detail)

Motion				
Color	C	V	H	Total
red	-	5	-	1
blue	-	3,5,7	3	4
green	-	1,3,4,5	3	5
Total	0	8	2	

Table 12 “Unchangeability” of image (See text for detail)

Motion				
Color	C	V	H	Total
red	6	4	7	17
blue	7	2	5	14
green	1	4	3	8
Total	14	10	15	

Table 12 shows the “Unchangeability” of the cases in which the image did not change whether the stimulus was presented steadily nor in any three kinds of motion. Tables 11 and 12 should consequently present opposite aspects of the results.

Despite of small discrepancies it is obvious that the image of red is stable for motion, and that of green unstable, and that the vertical motion has strong effect on color image.

Discussion

The red color has very strong image generally in that the

image changed least both due to shape (Table 10) and motion (Tables 11 and 12). Despite of that, the image of 2 (“soft-hard”) for red \bigcirc reversed against \triangle and \square . The image of 2 (“soft-hard”) seems affected due to shape more than color. This is what is suggested in Ohmi et al. (1971) which showed that the image of that scale was contributed both by color and shape.

The green color is easy to change due to both shape and motion. As for the effect of shape, the tendency in the present results is coincident with Tomita et al (1968).

The present results demonstrated that the image of green is also affected due to motion. The images of 1 (“like-dislike”), 3 (“thick-plain”), 4 (“elegant-vulgar”), 5 (“monotonous - changeful”) are easy to change due to motion particularly due to vertical motion.

It was seen that \bigcirc was affected due to color more than \triangle or \square with \triangle least indicating that \triangle is most stable as a shape.

The stability of red as a color and that \triangle as a shape may produce similar images, which was suggested in Babbit (from Tsukada, 1978).

The images 2 (“soft-hard”), 8 (“simple - tedious”) and 10 (“modern - ancient”) for red, 2 (“soft - hard”) for blue and 6 (“heavy - light”) for green were not affected due to shape and also due to motion (the image was stronger towards the right hand in each scale).

As for motion, the red resists to change its image due to motion just as same as due to shape, except for the image of 5 (“monotonous - changeful”). This image seems more affected generally due to motion (Tables 11 and 12).

Generally the image of 2 (“soft-hard”) is easy to change due to shape and those of 3 (“thick-plain”) and 5 (“monotonous-changeful”) are due to motion.

As for the motion itself, the circular motion does not have strong effect on the color image. The vertical motion, on the other hand, tends to shift the color image much.

Table 13 Reverse of image due to individual kind of motion

C: Circular, V:Vertical. H:Horizontal (See text for detail)

Color · Shape	Motion			Sub total
	C	V	H	
red ○	0	4	2	6
blue ○	0	4	1	5
green ○	3	6	1	10
Sub total	3	14	4	21
red △	4	3	2	9
blue △	4	7	5	16
green △	5	8	3	16
Sub total	13	18	10	41
red □	3	5	4	12
blue □	1	9	6	16
green □	1	6	7	14
Sub total	5	20	17	42
Total	21	52	31	

Table 13 summarizes the number of images which reversed in sign of the average point in each SD scale) between steady (motionless) and other kinds of motion.

It can be said again that color images of △ and □ are easier to change due to motion than ○ is and that vertical motion causes change in color image than circular or horizontal one.

Recent web designs are created increasingly using motion. Although the possibility to move simple ○, △ or □ of a color may be low, it should be reminded that there is difference among colors, shapes and motions in causing changes in color image.

Conclusions

- (1) The image of a color changes both due to shape and motion.
- (2) The image of green is easy to change generally both due to shape and motion.
- (3) The image of red, on the contrary, is least affected both due to shape and motion.
- (4) The image of color is most affected for the shape of \bigcirc when it does not move, and least affected for \triangle .
- (5) When the motion is introduced, the color image of \triangle and \square turned to be most changeable, and that of \bigcirc least.
- (6) The image of “soft - hard” is most changeable due to shape and the images of “thick - plain” and “monotonous - changeful” are most affected due to motion.
- (7) The circular motion does not change much the steady color image, and the vertical one does strongly.

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