

Effects of Hair Colors on the Optical Illusion of Body Types

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Abstract

The purpose of this study is to determine affects of hair colors on physical shapes and images through field survey and experimental research. For the purpose, this researcher surveyed 230 female college students residing in Busan about their dyed hair colors, and selected the subjects for the study. Then the researcher an experimental research on the subjects by suing test stimuli.

Results of the study can be described as follows: Experiment of the Optical Illusion of Physical Shapes.

For all items measured for the experiment, except four ones, if was found that hair colors provided significant efforts of optical illusion factor analysis, included horizontality, outlines of the body and face, a horizontal line of the shoulder, the length, verticality and a horizontal line of the face.

According to hair colors, black made the body look slimmer and the face look apparent. White made the body height look low, the outline of the face look clear and the neck or shoulder look fleshed. Female college students whose hair color was orange looked unclear in the body silhouette, bright in the face and broad in the hip and shoulder. Other students whose hair color was red, attracting the line of vision upward most strongly, looked fleshed in the upper body and broad in the face. Finally, blue made the face look dark.

Key words: hair colors, hair coloring, physical shapes, optical illusion

I. Introduction

Modern society fully enjoys economic wealth and modern people are endeavoring more efforts than ever for their own beauty. Owing to the rapid development of mass communications, people's desire for and pursuit of beauty have exploded to lead to the development of fashion and beauty industries.

Diverse hair dyeing originating from top entertainers and models is right in fashion among the public, and most women dye their hair.¹⁾²⁾³⁾ Also, some stereotyped concepts of hair colors

have gone way to colorful hair colors. Hair dyeing, therefore, has become a genre of total fashion for the positive effects of one's unique expression along with clothes, hair styles, and makeup.⁴⁾⁵⁾

Hair styles are as much important as faces to determine first impressions and images. Changing hair styles is more economical than buying clothes, and the effect of optical illusion can easily change face types.⁸⁾ So hair changes, like those by clothes, can be similarly great.⁹⁾

Out of human five senses, sight influences recognition by more than 70% and colors

determine sight by above 70%. That's why hair dyeing effects on body types and images are expected to be significant.

Among the researchers on hair rinse and conditioning products are M. Wong,¹²⁾ E. S. Abrutyn,¹³⁾ M. F. Jurczyk, D. T. Floyd & B. H. Gruning,¹⁴⁾ M. Westman,¹⁵⁾ 古川利正,¹⁶⁾ and 安間子.¹⁷⁾ Hair types have been studied by Kim Sunheui,¹⁸⁾ Kim Sujeong,¹⁹⁾ Yi Wongyeong,²⁰⁾ Jeong Sukheui,²¹⁾ Shin Heuisim,²²⁾ Oh Jimin & Oh Jiyeong,²³⁾ Oh Jiyeong,²⁴⁾ Bae Seonhyang,²⁵⁾ and Jeong Yeon.²⁶⁾ Hair dyeing likings and image changes have been reported by Choe Gwija,²⁷⁾ Na Yeongsun & Yu Hyeonju,²⁸⁾ and Yun Jiseong.²⁹⁾ In addition, papers on hair physiology related with dyeing are found in hygiene and medicine journals. But the effects of variously dyed hair colors on body types have rarely been researched.

This study, therefore, aims to reveal the effects of varied and fashionable hair coloring on body types and images, focused on the influences of hair colors on somatotypes.

II. Research Methods & Procedures

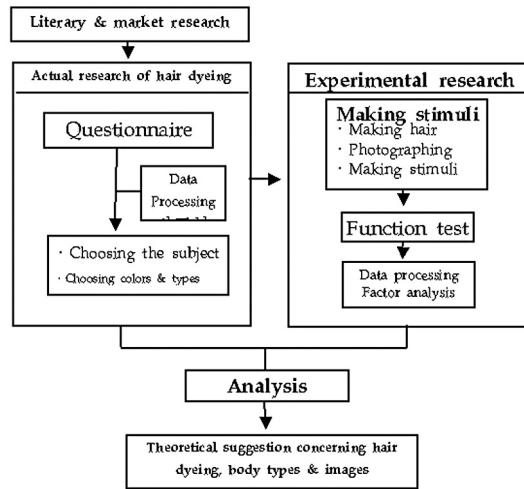
1. Research Diagram

Based on the first literary research, second experimental research was held as shown in <Fig. 1> below.

2. Actual Research of Hair Dyeing

1) Subjects & Period

230 female collegians answered a questionnaire from September 7 through 17, 2002. Excluding 25



<Fig. 1> Research diagram

incomplete copies, 205 copies were used for final analysis.

2) Contents

The questionnaire had 35 question items, and the final copy was completed after trust (0.78) verification.

3. Experimental Research

1) Choosing the Subject

30 women collegians at Dong-A University in Busan, Korea were randomly chosen and one subject who had the closest records to national standards (1999/ division: females age 18~24) was selected after physical measurements.

2) Making Stimuli

(1) Choosing Colors & Types

Based on the actual research of hair dyeing, six colors of hair (warm: red, orange; cold: blue, green; uncolored: white, black) most favored by

women in their twenties were chosen. The type of hair was long hair with a curl, also their favorite.

(2) Making Hair

First, human hair samples were manufactured. On the basis of Gu Bonmi et al.,³⁰⁾ hair was decolored. Second, bestselling hair dyes in six chosen colors were applied to the bleached hair. Thus prepared samples were taken to a wig factory for the manufacturing of the wigs with the same pattern and length.

(3) Photographing

(A) Costume & Posture of the Subject

The subject's costume was made of the material with some elasticity and the color similar to that of skin to prevent the interference of costume color. The face was applied basic makeup without coloring. The subject was made to stand with heels touching each other, front feet open at 30°. She wore the wigs of six colors by turns for the pictures in the front and the rear.

(B) Photographing Materials & Conditions

The film used in this paper was Fuji chrome provia 100F (RDP II)³¹⁾ D-type (daylight-type) favored by professional photo artists,³²⁾ color reversal positive film³⁶⁾ with less printing errors³⁴⁾³⁵⁾ compared with ordinary negative film.³³⁾ Film speed³⁷⁾ was ISO³⁸⁾ 100 to express natural and high-fidelity colors. The main lighting was daylight³⁹⁾ aided by flash cannon 540 EZ. As sunlight has conditions to express rich and exact colors around noon,⁴⁰⁾ 12~13:00 PM was chosen. Cannon-1N camera with the 85mm L lens was used for aberration correction.⁴¹⁾⁴²⁾ Based on the preceding research⁴³⁾ on coloring, light gray (N7: 342.4cm × 158cm) was used as the background.

(4) Making Stimuli Materials

The photographed stimuli were processed as

follows:

(A) Development & Computer Film Scanning

After the slide film was developed, it was scanned on the computer in order to decrease color errors in the printing process.

(B) Simulation

Grounded on the one-type hair pattern and posture, six colors of hair were prepared for color comparison in the same conditions. The simulated colors were not varied on the computer but went through photographing and film scanning by the subject wearing six kinds of wigs.

(C) Output

The little spots on the simulated photographs were removed by Photoshop 6.0 and the pictures were printed in the size of 8 10 inches.

(D) Stimuli Manufactured

The stimuli were made when the front-rear photographs of the subject with six-colored wigs were placed on the black form boards (91.3 × 61.5cm).

3) Function Test

(1) Date & Testers

120 collegians in their 20s with normal sight (above 0.8 by corrected sight) took part from November 20 through 31, 2002.

(2) Test Items & Methods

Conferring prior reports,⁴⁴⁾⁴⁵⁾⁴⁶⁾ the researcher made 19 test items of human silhouette after validity examination. Evaluation was made in 5-stage measures. For fair evaluation, each item was fully explained to the testers and the order of colors was randomly made.

4) Data Processing

SPSS/win (ver 10.0) was utilized for data processing. 1) For actual hair research,

frequency analysis (%) was done. 2) For the verification of body type optical illusion according to hair colors, dispersion analysis was made with Duncan test afterwards. 3) Factor analysis was held to reveal the factors of optical illusion with dispersion analysis for proof.

III. Results & Discussion

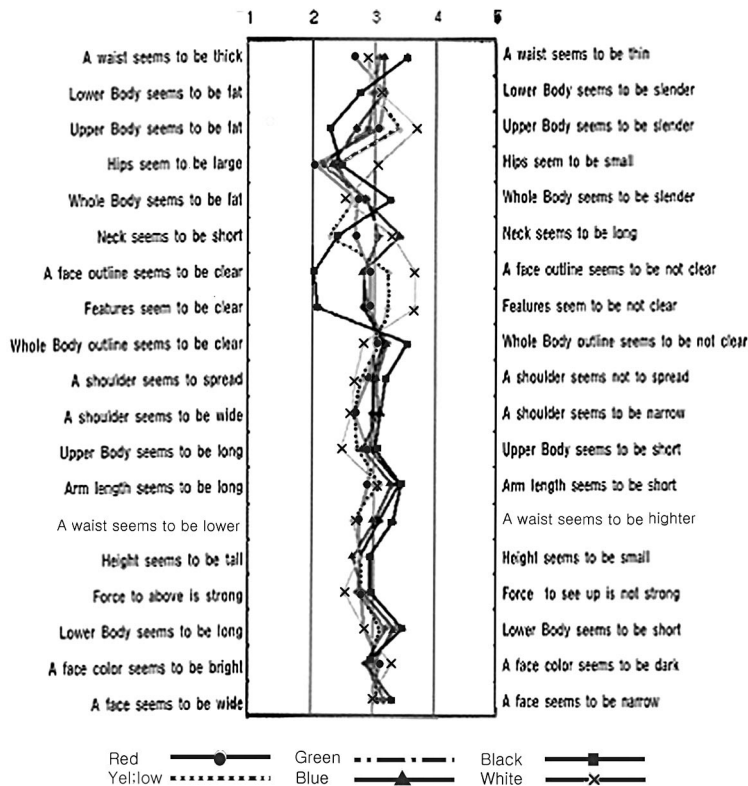
1. Dispersion Analysis:

Effects of Hair Colors on Various Parts of the Body

As seen in <Table 1>, significance was noticed

in all the items except four: "Looks taller/shorter," "Upper body looks longer/shorter," "Arm length looks longer/shorter," "Lower body looks longer/shorter." Therefore, hair colors are understood to have some effects of optical illusion on each part of the body.

<Fig. 2> represents the effects of somatotype optical illusion according to hair colors. "Red," in general, attracts eyes upwards and makes the body look fat, shoulders loose, hips and waist big. "Orange" makes a bright face, loose shoulders, and large hips. "Green" and "blue" show similar effects, but "blue" seems to darken facial color. "White" dims the silhouette and widens the face, while "black" tends to make a



<Fig. 2> Effects of somatotype optical illusion according to hair colors

<Table 1> Dispersion analysis: effects of hair colors on various parts of the body (N=120)

| Division | Item | Color | Red | Orange | Green | Blue | White | Black | F-value |
|--------------------------|------------------------------|-------|------|--------|-------|------|-------|---------|-----------|
| Body | Body looks fatter | | 2.68 | 2.88 | 3.07 | 3.15 | 2.89 | 3.51 | 7.06*** |
| | Body looks thinner | (c) | (c) | (b) | (b) | (c) | (a) | | |
| | Silhouette looks clearer | | 3.07 | 3.40 | 2.90 | 2.72 | 3.72 | 2.29 | 26.11*** |
| | Silhouette looks dimmer | (b) | (b) | (b) | (b) | (a) | (c) | | |
| | Looks taller | | 3.18 | 2.93 | 3.00 | 3.13 | 3.10 | 2.76 | 2.04 |
| Looks shorter | | | | | | | | | |
| Face | Silhouette looks clearer | | 2.93 | 3.23 | 2.85 | 2.83 | 3.65 | 2.04 | 28.16.*** |
| | Silhouette looks dimmer | (b) | (a) | (b) | (b) | (a) | (c) | | |
| | Face looks clearer | | 2.93 | 3.21 | 2.83 | 2.88 | 3.68 | 2.10 | 26.72*** |
| | Face looks dimmer | (b) | (a) | (b) | (b) | (a) | (c) | | |
| | Face looks brighter | | 2.70 | 2.28 | 3.08 | 3.42 | 3.29 | 2.43 | 20.5*** |
| | Face looks darker | (c) | (d) | (b) | (a) | (b) | (c) | | |
| Face looks wider | | 2.74 | 2.65 | 2.88 | 2.84 | 2.53 | 3.26 | 5.39*** | |
| Face looks narrower | (c) | (c) | (b) | (c) | (c) | (a) | | | |
| Neck & Shoulders | Neck looks shorter | | 3.03 | 3.06 | 3.16 | 3.21 | 2.82 | 3.54 | 5.75*** |
| | Neck looks longer | (c) | (c) | (b) | (b) | (c) | (a) | | |
| | Shoulders look loose | | 2.69 | 2.68 | 2.98 | 3.07 | 2.64 | 3.11 | 4.45*** |
| | Shoulders look tight | (b) | (b) | (a) | (a) | (b) | (a) | | |
| Shoulders look broader | | 2.91 | 2.80 | 2.98 | 3.03 | 2.69 | 3.20 | 2.96** | |
| Shoulders look narrower | (b) | (b) | (b) | (b) | (c) | (a) | | | |
| Upper Body | Attracts eyes upwards | | 2.03 | 2.33 | 2.17 | 2.33 | 2.47 | 3.05 | 10.34*** |
| | Hardly attracts eyes upwards | (c) | (b) | (c) | (b) | (a) | (d) | | |
| | Looks longer | | 2.81 | 2.81 | 2.75 | 2.83 | 2.54 | 2.97 | 2.03 |
| | Looks shorter | | | | | | | | |
| | Looks fatter | | 2.87 | 3.11 | 3.21 | 3.35 | 2.87 | 3.35 | 7.02*** |
| | Looks slimmer | (c) | (c) | (b) | (b) | (c) | (a) | | |
| Arm length looks longer | | 2.78 | 2.78 | 2.78 | 2.68 | 2.76 | 2.94 | .81 | |
| Arm length looks shorter | | | | | | | | | |
| Lower Body | Waist looks thicker | | 2.90 | 3.09 | 3.41 | 3.29 | 3.08 | 3.44 | 5.60*** |
| | Waist looks thinner | (c) | (c) | (a) | (b) | (c) | (a) | | |
| | Waist looks lower | | 2.90 | 2.75 | 2.94 | 2.82 | 2.48 | 3.02 | 4.14*** |
| | Waist looks higher | (a) | (a) | (a) | (a) | (b) | (a) | | |
| | Looks fatter | | 3.01 | 3.10 | 3.19 | 3.18 | 2.98 | 3.31 | 1.74 |
| | Looks slimmer | | | | | | | | |
| | Looks longer | | 3.12 | 2.95 | 2.88 | 3.02 | 3.30 | 2.91 | 2.61* |
| | Looks shorter | (b) | (b) | (b) | (b) | (a) | (b) | | |
| Hips look bigger | | 2.75 | 2.68 | 3.10 | 3.02 | 2.69 | 3.32 | 7.15*** | |
| Hips look smaller | (c) | (c) | (b) | (b) | (c) | (a) | | | |

* P ≤ 0.05, **P ≤ 0.01, *** P ≤ 0.001

According to the results of Duncan test,

different groups with significance are differently represented (a>b>c>d).

thin body, a small face, clear silhouette, slim upper body, and a long neck.

In relation with body types, the traits of colors such as progress/retrogress and shrinkage/expansion are used in the design of upper/lower clothes. Slim people wear clothes with expanding colors like yellow, red, and orange, while obese people prefer shrinking colors like blue and green.⁴⁷⁾⁴⁸⁾⁴⁹⁾⁵⁰⁾

Likewise, as red and orange belong to the colors of expansion, fat people are asked to refrain from the use of those colors. However, unlike the theory, blue and green did not have great shrinkage effects. Black was most effective

in shrinkage, and white displayed greater expansion effects than red and orange.

2. Factors Representing the Effects of Somatotype Optical Illusion According to Hair Colors

1) Factor Analysis

Factor analysis was held regarding the 19 items of body types. Direct rotation by way of the varimax method was employed. As a result, six factors above 1 eigen-value, explaining the effects of somatotype optical illusion according to

<Table 2> Factor analysis results: somatotype optical illusion according to hair colors (N=120)

| Item | F 1 | F 2 | F 3 | F 4 | F 5 | F 6 |
|---|------------|------------|-----------|--------|----------|-------|
| Waist looks thicker Waist looks thinner | .703 | .015 | .131 | .075 | -.085 | -.036 |
| Lower body looks fatter Lower body looks slimmer | .672 | .024 | -.025 | -.024 | .061 | .086 |
| Upper body looks fatter Upper body looks fatter | .647 | -.125 | .104 | .069 | .094 | .284 |
| Hips look bigger Hips look smaller | .642 | .084 | .177 | .147 | .011 | -.088 |
| Body looks fatter Body looks slimmer | .504 | -.244 | .350 | -.110 | .237 | .089 |
| Neck looks shorter Neck looks longer | .464 | .347 | .239 | -.110 | -.408 | -.107 |
| Face silhouette looks clearer Face silhouette looks dimmer | -.122 | .892 | -.045 | -.017 | .056 | .032 |
| Face looks clearer Face looks dimmer | -.103 | .867 | -.049 | -.060 | .086 | .054 |
| Body silhouette looks clearer Body silhouette looks dimmer | -.043 | .706 | -.091 | -.054 | .309 | -.149 |
| Shoulders look loose Shoulders look tight | .162 | -.08 | .833 | .136 | -.019 | .089 |
| Shoulders look broader Shoulders look narrower | .238 | -.04 | .829 | .086 | -.080 | .082 |
| Upper body looks longer Upper body looks shorter | .156 | -.01 | .088 | .759 | -.045 | .195 |
| Arm length looks longer Arm length looks shorter | -.057 | .012 | -.104 | .704 | .187 | -.163 |
| Waist looks lower Waist looks higher | .046 | -.08 | .238 | .693 | -.034 | .106 |
| Looks taller Looks shorter | -.025 | .108 | -.058 | .241 | .649 | -.202 |
| Attracts eyes upwards Attracts eyes downwards | .053 | .260 | .038 | -.014 | .607 | .199 |
| Lower body looks longer Lower body looks shorter | -.203 | .111 | .108 | -.175 | .228 | -.601 |
| Face looks brighter Face looks darker | -.201 | .279 | .160 | .009 | .171 | .536 |
| Face looks wider Face looks smaller | .299 | -.291 | .251 | -.058 | .200 | .448 |
| Factor Characteristics | Horizontal | Silhouette | Shoulders | Length | Vertical | Face |
| Eigen-value | 3.871 | 2.136 | 1.686 | 1.163 | 1.092 | 1.018 |
| Dispersion (%) | 20.37 | 11.24 | 8.876 | 6.124 | 5.750 | 5.537 |
| Accumulated Dispersion (%) | 20.37 | 31.61 | 40.48 | 46.61 | 52.36 | 57.71 |

<Table 3> Factor items & contents

(N=120)

| F | Optical Illusion Items | Contents |
|---|---|---|
| 1 | Horizontal | Waist, body, upper/lower body, hips, neck |
| 2 | Body/face silhouette | Face silhouette, face, body silhouette |
| 3 | Horizontal (shoulders) | Shoulders (tightness/size) |
| 4 | Length | Upper body, arm, waist |
| 5 | Vertical | Height, attraction upwards |
| 6 | Horizontal (face) & lower body (length) | Face brightness/size, lower body |

hair colors, were decided and they constitute 57.71% of the dispersion. <Table 2> and <Table 3> indicate the results of factor analysis.

Factor 1 has six items including “Waist looks thicker/thinner,” “Upper and lower body look fatter/slimmer,” and “Body appears fatter/thinner.” This factor explains the horizontal effects of optical illusion. Its eigen-value is 3.87, explaining 20.37% of the dispersion.

Factor 2 has three items like “Face silhouette looks clearer/dimmer,” “Face looks clearer/dimmer,” and “Body silhouette looks clearer/dimmer.” This factor stands for the effects of optical illusion in body and face silhouette. Its eigen-value is 2.13, explaining 11.24% of the dispersion.

Factor 3 belongs to the effects of optical illusion in shoulders, holding two items of “Shoulders look loose/tight” and “Shoulders look broader/narrower.” Its eigen-value is 1.68 and explains 8.87% of the dispersion.

Factor 4 is about upper body three items such as “Upper body looks longer/shorter,” “Arm length looks longer/shorter,” and “Waist looks longer/shorter.” Eigen-value is 1.16 with the explaining power of 6.124%.

Factor 5 is about the vertical effects of optical illusion. Its eigen-value is 1.092, explaining 1.018% of the dispersion. Its two items are “Body looks taller/shorter” and “Attracts eyes

upwards/downwards.”

Factor 6 includes face & three lower body-related items like “Face looks brighter/darker,” “Face looks wider/narrower,” and “Lower body looks longer/shorter.” Eigen-value is 1.02, explaining the dispersion as much as 5.54%.

2) Analysis of Factor Characteristics According to Hair Colors

<Table 4> shows the results of dispersion analysis concerning the factor traits according to hair colors. Significance is seen in every item. The effects of horizontal optical illusion appeared in the order of black > blue/green > orange/white/red. In particular, as the favorite colors of red and orange tend to have great effects of horizontal optical illusion in terms of waist, upper/lower body, hips, and neck, special care is needed in wearing clothes at the time of dyeing hair red or orange.

White > orange > red/green/blue > black was the order of body/face silhouette optical illusion. So silhouette-emphasizing makeup is necessary when dyeing hair white or orange.

Black > blue/green > red/orange/white was the order in horizontal optical illusion in shoulders. The first three colors seemed to have cool and cold images. The order of optical illusion effects in length was black/red/green/orange/blue > white, while that of vertical effects was by contrast

<Table 4> Dispersion analysis results of factor characteristics according to hair colors (N=120)

| Optical Illusion Factor \ Item | Red | | Orange | | Green | | Blue | | White | | Black | | F-value |
|---|-------------|-----|-------------|-----|-------------|-----|-------------|-----|-------------|------|-------------|-----|----------|
| | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD | |
| Horizontal | 2.87 (c) | .64 | 2.98 (c) | .65 | 3.18 (b) | .60 | 3.19 (b) | .66 | 2.88 (c) | .72 | 3.43 (a) | .73 | 12.83*** |
| Body/face silhouette | 2.97 (c) | .84 | 3.28 (b) | .93 | 2.86 (c) | .78 | 2.80 (c) | .91 | 3.68 (a) | 7.00 | 2.14 (d) | .94 | 38.78*** |
| Horizontal (shoulders) | 2.80 (b) | .91 | 2.73 (b) | .93 | 2.97 (a) | .96 | 3.05 (a) | .06 | 2.66 (b) | 1.22 | 3.15 (a) | .97 | 4.30*** |
| Length | 2.82 (a) | .73 | 2.78 (a) | .75 | 2.82 (a) | .80 | 2.77 (a) | .86 | 2.59 (b) | .75 | 2.97 (a) | .81 | 3.02** |
| Vertical | 2.60 (b) | .79 | 2.67 (b) | .82 | 2.58 (b) | .84 | 2.72 (b) | .88 | 3.07 (a) | 1.01 | 2.61 (b) | 1.0 | 5.06*** |
| Horizontal (face) & lower body (length) | 2.85 (b) | .54 | 2.62 (c) | .73 | 2.94 (a) | .60 | 3.09 (a) | .60 | 3.03 (a) | .65 | 2.86 (b) | .73 | 7.87*** |

*** P ≤ 0.001, ** P ≤ 0.01

According to the results of Duncan test, different groups with significance are differently represented (a>b>c>d).

white> blue/orange/green/red/black.

In the face effects, the order was blue/green/white> red/black> orange. So blue and green had the greatest effects of making something look small as well as their cold images.

In sum, therefore, hair dyeing colors appear to have the effects of optical illusion around the parts surrounding the hair. As hair colors have much to do with partial or total body, hair dyeing might have to take the dyeing person's body type into full consideration.

IV. Conclusions

This is a combination of an actual examination and an experimental study. In order to know the effects of hair colors on body types, 230 female collegians residing in Busan were given a questionnaire on the reality of hair dyeing. Based on the actual research, one subject was selected

and stimuli were manufactured. The analysis and examination of the effects of hair dyeing on somatotypes have produced the following conclusions:

1) According to the results of dispersion analysis on the somatotype effects of optical illusion by way of hair colors, most items (excluding 4) had some significance.

2) Factor analysis revealed 6 factors leading to the effects of optical illusion: 1 (horizontal), 2 (body/face silhouette), 3 (horizontal; shoulders), 4 (length), 5 (vertical), 6 (horizontal; face & lower body; length).

3) In the division of colors, "black" tends to make a thin body and clear silhouette, "white" dims face silhouette and makes one shorter with fatter neck/shoulders. "Orange" makes a bright face, wide shoulders, and large hips. "Red" attracts eyes upwards and makes upper body look fat, and the face bright and wide. "Blue" seems to darken facial color.

In short, already a popular and public part of fashion, hair dyeing has the effects of optical illusion on body types, both in part and on the whole. That's why the dyeing person's body type needs to be taken into consideration. In addition, colors of hair dyeing should be carefully selected in the light of one's own body type, favorite clothing colors, and pursuing images. This study hopefully begins the fundamental research in the line of hair color effects on the optical illusion of body types. However, as the subject's hair style and length were limited for the convenience of analysis here, the findings of this research cannot be generalized. Some further research will have to follow for the comprehensive and systematic theories regarding hair colors and dyes.

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