

**THE PROBLEM OF SUITABILITY IN VISUAL PERCEPTION**  
**(ABSTRACT)**

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**PART I**

**1. Problem.**

In this report some aspects of the problem of suitability in visual experience have been examined experimentally, the results analyzed, and some conclusions drawn. Many situations in daily life illustrate aspects of the problem considered here. A colleague or friend enters your office, you look up from your work and remark perhaps to yourself, "how nice you look, your scarf is exactly right with that blouse and the whole ensemble suits you extremely well." Or, in the evening on your way from the theater hurrying home along the old İstiklâl Caddesi your eye is caught by a good looking tie in a shop window and you notice how admirably it suits the jacket of the lay figure and you stop for a moment to enjoy the pleasing visual experience. Such every-day experiences illustrate the problems of this study.

What we perceive and how we experience our perceptions have constituted some of the primary problems of humanity. The pleasant and unpleasant emotions aroused by the perceived objects have since ancient times presented challenging subjects for consideration to philosophers, students of aesthetics, artists and today also to industry.

Artists have necessarily labored over this problem most. But, what an artist finds is also what he creates. On the other hand, the scientific attitude of the psychologist in viewing a work of human art is not very different from that in facing a work of Nature. In this area are many problems that scientists have yet to solve.

In the present investigation the problem has been approached through

experiments designed to reveal affective responses to combinations of colors and forms. The subjects who cooperated in these experiments were college students and college graduates who had no specific training or special interest in art.

The experiments were in three parts :

First, the Ss were asked to make combinations that they felt were pleasing using colored papers and matching pieces of colored cloth.

Second, the Ss were instructed to make harmonious combinations of simple black forms on one of four white paper backgrounds. The backgrounds were in four different simple forms.

Third, the second instruction was repeated, this time using forms in 10 different colors against gray backgrounds.

## 2. Design of the Experiments with Colors

The materials used for the experiments with colors were 41 colored papers and 41 matching colored pieces of cloth, rectangular in shape and in size 7×10 cm.

In daily life, the chromatic and achromatic colors are used together without distinction as in clothing, in decoration and in art. In order to approach the real life situation neutral colors (6 grays), a white, and a black were presented together with 24 other colors from Hering's circle plus 9 other colors in common everyday use (4 browns, 3 pinks, and 2 tans). All these 49 colors were matched with the colors in "The British Colour Council Dictionary of Colours for Interior Decoration, 1949", and their names are given in English in Table A of the Appendix\*. The materials were also checked with the Munsell System which best expresses in scientific terms the saturation and brightnesses of individual colors. For the Munsell equations, see Appendix, Table B.

Of the colored papers 24 were cut out of matte colored Hering papers available at the Laboratory. The remainder were painted evenly with poster color on drawing paper of the same size. The matching pieces of cloth were mounted on cardboard of the same size in order to avoid wrinkling by touch. To secure the matte effect only woolen or cotton cloth was used.

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\* The Appendix is not included here due to limited space. A copy of the original text is placed in the Psychology library with the Appendix.

The experiments were in 4 parts :

Series 1. Two color combinations utilizing 41 paper and 41 cloth pieces. (20 Ss)

Series 2. Three color combinations, 41 paper and 41 cloth pieces. (20 Ss)

Series 3. Ranking as to their relative attractiveness of the 2 color combinations resulting from the choices in Series 1. (Paper, 40 Ss)

Series 4. Ranking as to relative attractiveness of the 3 color combinations resulting in Series 2. (Paper, 40 Ss)

In Series 1 and 2 the experiments were made in a first session with paper material, and in a second session a day later were repeated using the cloth material. The Ss required about half an hour for each session. The experiments were made in daylight at a table placed near the window, the subject seated to the left of the window. The material was spread randomly on a table of size 79×138 and 78 cm. high, and of a tan color\*.

The instructions given to the Ss were these :

"Here are 41 rectangular papers (or pieces of cloth) of different colors. It is possible to make many combinations of two colors from these\*\*. Look at these colors carefully and then make:

a) 5 different combinations of two colors each that are pleasing for you, that you feel you would like to make,"

The Ss were assured that these experiments had nothing to do with intelligence or personality tests. The experimenter made no suggestions to the Ss as to possible combinations. The Ss were free to take all the time they needed to finish the task. As soon as the S had made a choice the E wrote down the results. The S was then asked to make,

\* The reasons for not using a neutral background in this part of the experiments, were:

- a. Neutral colors were present in the experimental series, and the background of the same color might have drowned them.
- b. The color of the table was unlike every color used in the experiments and as it was also a familiar and usual color for a table; it would tend to be ignored.

$$** \frac{N(N-1)}{2} = \frac{41(40)}{2} = 820$$

- b) 5 blouse and skirt combinations for women.
- c) 3 blouse and skirt combinations 1 each for a blond, a dark, and a brunette.
- d) Blouse and skirt combinations one each for a stout and a slender woman.
- e) Blouse and skirt combinations for a short and a tall woman.  
(17 combinations in all.)

After each series of selections were made, the results were recorded by the E. The selected material was then mixed with the others, and the instructions for the next series were then given to the S. As was previously stated, each series was repeated the following day using mounted cloth samples as material.

The Ss invited to take part in these experiments were 40 men and 40 women between 22 and 33 years old. They had no special training or interest in Art. They were students at the University, graduates and undergraduates whose major subject was psychology, physics, English philology, economics, or pedagogy. "The Ishihara Test for Colour-Blindness" was given to the Ss before the experiments began and the results for those who were either color-blind or color-anomalous were not included in the analyzed results.

### 3. Results.

**A. First Series of Experiments.** The results of the 2 color combinations were studied with reference to the relations of the chosen colors to each other. The combinations made by the Ss were classified into 3 main groups:

- 1 — Combinations using two chromatic colors. (2C).
- 2 — Combinations using one chromatic and one achromatic color. (A)
- 3 — Combinations of two achromatic colors. (2A).

Analysis of the results yielded 6 subgroups for main group 1 (2C), 2 for main group 2 (A), and 2 for main group 3 (2A). There were thus 10 subgroups in all.

#### 1 — Analysis of the combinations of two chromatic colors. (2C)

a) Combinations made leaving a long color scale interval between the two colors chosen. These to be of 5 kinds:

i. Combinations of two complementary colors: (2CK) On Hering's Circle of colors red and green, orange and bluish-green form such combinations.

ii. Combinations of two almost complementary colors of the same brightness: 2CR<sub>(ac=)</sub> K

iii. Contrasts made between one primary and one secondary color: 2C<sub>(ast)</sub> K

iv. A slight contrast between two neighboring primaries of the same brightness: 2C<sub>(Yac=)</sub>

v. Two chromatic colors combined with brightness contrast: 2CK<sub>g</sub>

b) Gradation effect, using two neighboring colors: (2Cg)

2. Combinations of one chromatic and one achromatic color: (A)

a) A chromatic color combined with an achromatic color producing brightness contrast. (AK)

b) A chromatic color combined with an achromatic color producing brightness gradation. (Ag)

2. Combinations using two achromatic colors: (2A)

a) Brightness contrast of two achromatic colors: (2AK)

b) Brightness gradation of two achromatic colors: (2Ag)

In Table I (p. 21) the results for 20 Ss on the two-color combinations and for the blouse and skirt combinations are recorded (colored paper and colored cloth separately) for the different choice groups. The two-color combinations and the skirt and blouse combinations proved to be similar. So these were combined in Table Ia. (p. 22) From these two tables it may be seen that:

a) The highest frequency among the main groups is found in combinations using one chromatic and one achromatic color: (A)

b) The highest frequency among all the groups is found in contrast effects made by using a chromatic and an achromatic color: (AK)

c) The second highest in frequency is the chromatic color gradation: (2Cg)

d) The least used combinations are two achromatic color gradations.

Comparison of the results between "pleasant color combinations" using two colors and "pleasant skirt and blouse combinations" with no other specifications, shows the same quality of choice in both,

1. a brightness contrast or
2. a hue gradation.

In the remaining series the Ss were asked to make skirt and blouse combinations for specified types, namely, for a blond, a dark blond, and a brunette, a stout and a slender, a tall and a short person. The highest frequencies in each group are shown in Table Ic (p. 24) In this series:

1. The brightness contrast of one chromatic and one achromatic color that showed a high frequency in the simple choice experiments appeared even more popular when the choices were applied in specific situations. It appeared that familiar combinations used in daily life, especially in clothing, were made use of in abstract situations as well. (i.e. in the simple choice combinations.)

2. In the skirt and blouse combinations the complexion of the wearer seems to have little or no influence on the character of the chosen combinations. Here the individual colors played perhaps their most important role.

3. The build of the wearer had some influence on the skirt and blouse combinations. The choices for short and stout resembled one another, but differed considerably from those for slender and tall which also resembled one another.

a) The Ss used almost the same combinations for short as for stout persons, using either two achromatic or one achromatic and one chromatic color in these combinations.

b) The results for the slender and tall Ss resembled one another closely. Here two chromatic color combinations tend to be the usual choice. Especially the women Ss use chromatic color contrasts for both the slender and the tall, frequently for the first time.

### **B. Results of the Second Series of Experiments.**

In the second series of experiments three different colors were to be combined. The instructions to the Ss were similar to those in the first series except for the change from 2 to 3. To the skirt and blouse combinations a scarf was to be added. The same 10 men and 10 women Ss took part in this second series. Again the experiments were repeated, first a paper series and then one using the cloth samples. The choices can now yield four possible combinations:

1. Three chromatic colors: (3C)
2. Two chromatic and one achromatic color: (2CA)
3. Two achromatic and one chromatic color: (2AC)
4. Three achromatic colors: (3A)

The subgroups for these are 26 in number. In the first group there are now 4 subgroups, of these the most frequent is made up of two neighboring colors together with a complementary color. This gives a rather intense contrast effect:  $3C_{(K_1+g_2)}$

Second highest in frequency among the chromatic combinations are gradations (3Cg).

Analysis of the (2CA) combinations reveals 15 subgroups. Some of these are contrasts of various sorts like those explained in Part I. The others are various combinations with a dominant gradation.

The (2AC) group shows 6 subgroups dominated variously by brightness gradation or brightness contrast.

In the (3A) group brightness gradation only is dominant.

In Table II (p. 27) the frequencies are shown in all groups of the first two series of experiments. (Pleasant color combinations, scarf and blouse combinations.) From this table it is seen that:

1. The combinations made by using two neighboring chromatic colors with a contrasting achromatic color has the highest frequency:  $3C_{(K_1+g_2)}$ . This is followed by,
2. A brightness contrast secured by using two contrasting achromatic colors with a third contrasting chromatic color: (2AKCK)
3. Chromatic color gradations follow these two in frequency: (2Cg-AK, 3Cg).

In the last group of experiments in this section the Ss were, as before asked to make their combinations for special cases. In **Table IIe** (p. 29) the most frequent choices for different cases are shown.

The results here show that;

1. When choices are made of combinations for special cases, neutral colors and neutral combinations are more frequently preferred as also in daily life.
2. The hair and complexion of the persons in the special cases does not seem to influence the character of the combinations except in one

interesting instance. The men Ss diverged from their usual pattern in their choice of individual colors for blonds.

3. The size of the "wearers" seems to play at least some part in the combinations here as also in the previous experiments.

### C. Results of the Third Series of Experiments.

The results of the first two series of experiments (with 20 Ss) revealed what seemed to be quite stable results. The third and fourth series were prepared with these results in hand. They were designed to check the results of the earlier findings.

It may be recalled that the first series of experiments resulted in combinations of 2-colors which were easily classified in 10 combination type groups. The material for the third series was prepared by selecting randomly three examples that the Ss had composed, from each of the first 9 of these groups. In the 10th group (2CY<sub>(Yac=)</sub>) no more than two combinations could be made; hence a total of 29 pairs of 2-color combinations were available as experimental material for the Third Experimental Series. These 29 pairs of 2 colors each, (paper, 7×10 cm.) were then pasted side by side. The experiments were conducted, as before, in daylight near the window, the materials were placed, as before, in a random arrangement on the table described above.

The instructions to the Ss in experiment three were these: "please select from these combinations the 5 pairs of colors that you like best, the ones you find most pleasing, and rank them from 1 the best liked, to 5 the least preferred." When this was done the five chosen pairs were removed from the table. The Ss were then asked to choose the five pairs that they liked least among the remaining 24 pairs and to rank them in order from the least desirable upward. This group was then also removed. The S was now asked to select from among those remaining the 5 best liked or most pleasing pairs and to rank them. After removing these also, the remaining four pairs were similarly ranked by the S. The 29 pairs could now be arranged from 1 to 29 in terms of the preference of each S. The Ss who cooperated in Series three were; First, the 20 Ss from Series 1 and 2, and following them, another 20 Ss, 10 men and 10 women chosen to resemble the first group in age and academic status. The choice results of the two S groups were then compared as follows:

The pairs in each sub group were ranked according to the frequency

of their occurrence in the First Experimental Series. Two groups were equal in position (2Ag, 2CG<sub>3</sub>) and their results were combined in the analysis. The three examples in each sub-group were given the rank order of the group. E.g., the pairs P<sub>1</sub>+Si, M<sub>13</sub>+G<sub>6</sub>, T<sub>3</sub>+G<sub>1</sub> of group AK, were all assigned AK's rank no. 1. Choices made by each S. were rated by calculating the average of the individual deviations from the average of the total group in the original series. The individual deviation of each S in every choice is reported in the Appendix, Table III a and III b. In Table III (p. 32) the individual choice values from the Third Series of experiments are presented together with the calculation of their rank-difference correlation. The correlation coefficient = .70 and .71, C.R.=2.0, P=0.5, when the average of the two groups are lumped together. These results seem quite promising. The degree of correlation indicates a fairly reliable stability in individual choice trends. The taste of the men Ss as indicated by their selections may be somewhat cruder than that of the women, but the difference is probably not statistically significant.

#### D. Results of the Fourth Series of Experiments.

1. **Part I.** The first part of the Fourth Series of Experiments were made to control the results of the Second Series of Experiments. At the end of these Second Series the results were classified under 26 different groups, as was explained previously. Thinking that the admission of examples from all these groups might cause difficulties at the application of the experiments a series of materials was prepared by taking two examples from the first five most frequent group. The materials were prepared as in the previous series by pasting in each case the three rectangular colored papers side by side in a row.

At the beginning of each session the new material consisting of 20 tricolored cards was as before spread in a random order on the same table situated similarly by the window. The Ss were first asked as in the Third Series to choose the five most agreeable combinations and then to rank these five in their order of preference. They were then asked to select from the remaining 15 tricolors the five least agreeable combinations and then to rank these 5 in order. Next, they were asked to choose and rank the 5 more agreeable of the 10 cards remaining. And finally, the last five were ranked from least to most liked. Again from this procedure the Experimenter could make a rank order from best to

least liked for each subject. The frequency ranks of the last four groups in this series coincided exactly with their ranks in the Second Series of experiments, thus, forming as before a series of seven ranks. In Tables IVa and IVb, of the Appendix appear the deviations of the rank values of the two groups of Ss from the averages in the Second Series of Experiments.

In Table IV (p. 34) the rank-difference correlations are entered for the two groups of Ss. From this table it appears that the individual deviations have a P value of .05 or less, with an even higher consistency value than in the previous experiments.

**Part 2: Experiments on the relative pleasure derived in the arrangement of 3 different colors in combination.**

In the previous part of the Fourth Series the materials were taken directly from the combinations made by the Ss. But it should be recalled that a majority of these were composed with a certain specific objective, such as, selecting a scarf that would harmonize agreeably with a skirt and blouse, hence tending to follow a typical sequence.

Inspired by Schulte's experiments on pleasing arrangements of colors, a series of experiments were designed in the present study by presenting to the subjects the very material chosen and arranged by them in threes, asking them now to arrange these combinations in an order of agreeable affect. In Table IVc (p. 37) appear the results of these rankings. The arrangements that agree with those of the previous experiments are underlined. From this table it is clear that, the arrangements made for scarf-blouse-skirt combinations are not always those most frequent arrangements made in this new occasion.

From these results we see that when three colors are given to the Ss with the request to arrange these in a pleasing order, a kind of color balance appears in the arrangements, viz:

- 1 — Of three colors, if two have a short wave length, and one a long wave length, the latter is usually placed in the middle.
- 2 — If two colors have a long and one a short wave length, the latter is placed in the middle.
- 4 — If two colors are chromatic, and one achromatic, the achromatic color is placed in the middle.
- 5 — Three neighboring chromatic colors are usually arranged by placing the medium brightness in the middle.

6 — Three achromatic colors are usually arranged, by placing the medium brightness in the middle.

That the Ss do not arrange the separate colors in a random order is clearly evident from these results. For example, a S who chooses black as a skirt with a gray blouse and a red scarf, when given the same 3 colors in an abstract situation, places red in the middle.

At any rate, it is obvious that the S considers the given situation and tries to create the most desirable effect with the materials available. He achieves this in the abstract situations by placing the contrasting color in the middle, balancing the achromatic colors on each side.

#### 4. Summary and Result of the Experiments with Colors.

The first part of the present study on the problem of suitability in visual perception consisted, it may be recalled, of four series of experiments with combinations of two and three colors. In the first two series the Ss made their own combinations, and in the last two series, combinations made from their results were presented to them for preference ranking as a control of the previous experiments. The results of the last two series confirmed the findings of the first two.

In contrast with early investigators in this field, it is possible for us on the basis of the results of these experiments to accept a general preference system or hierarchy of choices with respect to colors. Reviewing the results in the present series of experiments it appears that a pleasing effect is most often evoked by a combination involving a brightness contrast (one chromatic and one achromatic color.) Second in frequency is a combination producing a gradation effect resulting from an arrangement of two neighboring chromatic colors.

When three colors were used in combination the same trends appeared. Confronted with more possible choices the Ss made more interesting combinations under the same general rules. Observations made utilizing familiar every-day problems of costuming: the selection of harmonious color combinations for women's clothing, tested the validity of the first two series of our experimental results. Several current fashion magazines were collected and the contents (colored plates) were studied and analyzed with respect to skirt and blouse combinations in a similar systematic way to that used previously with the experimental choices made by the Ss of our experiments.

One hundred samples selected at random were then subjected to study and the results tabulated. From Table I d of the Appendix where the results appear it may be seen that (though the present frequency of chromatic combinations approaches nearer to the results in choices combining one achromatic and one chromatic color) the trends revealed in the results in general are surprizingly similar to those of the various experimental choice combinations. Further observations were made informally without systematic tabulations of published works on interior decoration, also colored posters and arrangements in shop windows. Some decorators were interviewed with respect to this matter. The various findings from these several approaches led the investigator to believe that the results of the present experiments showed a definite and interesting parallel to conscious and studied applications in related walks of daily life.

The recent psychological literature shows agreement with the findings of the present research and discussion. Eysenck<sup>5</sup> and Granger<sup>6</sup> (p. 39) have found preference series in their experiments with color combinations. Eysenck using Ostwald's chromatic colors reports that, the larger the interval between the hues, the more highly the combination was rated by the Ss. Granger also in recent work on preferences for individual colors and color combinations, derives experimentally a general preference system similar to the one enunciated above in our study. Granger also concludes that color pairs are preferred according as the interval between them lengthens. He finds further that this rule stands, without respect to the pleasantness of individual colors.

As a result of our own experiments, some general rules have emerged with respect to the choice of suitable color combinations. The similarity of resulting trends is the more striking since our experiments are rather different in structure from the other studies known to us. In the latter, color pairs were presented in the form of paper samples to the Ss with the request to select their choices from these. In our experiments, colored materials were presented to the Ss from which they were to make their own pleasing or suitable combinations. Achromatic colors were also included in our series, so far as we know an innovation. This novelty was made use of because although black, white and grey series are called "colorless colors" in the psychological nomenclature, in daily life, a black, white or grey blouse may be as colorful as a red or blue one.

Naturally, some differences in results were found to emerge in consequence of the conditions of the experiments. In our experiments as in those of the other contemporary investigators a considerable frequency occurred of chromatic color combinations with large intervals between the colors selected. But, our most frequent combinations were those that secured a brightness contrast through the choice of a chromatic with an achromatic color, which was possible under the conditions of our experiments. It was only when, as a result of comparisons involving (a) the first and third and (b) the second and fourth series of experiments, deviation curves were plotted for the various groups of Ss that this finding stood forth; the lowest point on these curves (and hence the greatest similarity in trend) was in every case at the point of chromatic contrasts. The rules accepted by several recent investigators although they are not the most dominant of all in the present series (as indicated by frequencies in these experiments conducted under different conditions) have yet proved to be the least deviant from one of our experiments to another.

In concluding this first part of the present study, it may be useful to glance at conclusions respecting color harmonies reported by Ralph M. Evans at a meeting of the ICI in New York City in 1953. Evans, taking the color circle into account, accepted four theoretical rules on color combinations: The first two of these formulate (a) the gradation effect secured by using neighboring colors, and (b) the contrast effect evoked by complementary hues. Evans' third rule (c) relates to the result of a color combination made when an equilateral triangle is inserted into the color circle, and any 3 colors are combined together that touch the points of the triangle in any position. The fourth rule (d) applies to the combination of the four colors touching the points of any hypothetical square inserted in the circle.

It is of interest to discover that some of the results of our experiments made with lay Ss in a sense illustrate rules established by experts in the field of color.

## **Part II: Experiments with Forms.**

1 — **Design of the Experiments.** Two sets of simple forms were used. The first prepared in black, the second prepared in various colors. All were cut from medium weight artist's paper. For the first series 51 black forms were cut, also 4 white backgrounds. The backgrounds were

also in simple forms: a square, a rectangle, an equilateral triangle and a circle of almost equal area.

The 51 small figures included the four forms used also in the backgrounds, various combinations of these, and in addition a few other forms familiar in decorative art. Fifteen groups resulted, each form in every group being present in 3 sizes. The largest size in each group was small enough to permit the easy formation of compositions on the several backgrounds. The forms and dimensions of the small figures and the larger backgrounds are presented in detail in Table G of the Appendix.

The materials used in the Second Series were in the same forms, prepared in 10 different colors: 4 primaries, 4 secondaries, a white, and a black. There resulted 510 figures in 15 groups. The colored forms were prepared by pasting Hering papers on cardboard. In Table H of the Appendix, the figures of one group are shown to illustrate the materials used. The background forms for these experiments were prepared from gray artist's paper of medium brightness.

All of the experiments of Part II were conducted in broad daylight, near the window on the table previously used and described above. The materials were presented in a semicircle in a fixed order the different sizes in each form group being placed one above the others according to size with the smallest on top. Thus all were, if not wholly, at least partially visible to the S. A statement was made to each S which reads approximately as follows:

"Here are 15 groups of simple forms in three different sizes. You are first to get acquainted with the appearance of the forms. You may look at them and move or lift them, if you want to. When you feel that you are really acquainted with the materials, please tell me." When the S so indicated he was asked to "select (a) (i) a pair of pleasing figures". "It may well be possible to select many pleasing pairs, however you are asked to select just one from among them all."

The experimenter then made notes on the S's choice. Next, the figures were returned to their standard positions as described above. Now the S was asked to "select (ii) 3 harmonious figures, i.e. that seem to go together agreeably and suitably, (iii) 4 harmonious figures "and finally, (iv) 5 harmonious figures", in each instance starting from the standard position.

After these 4 tasks had been completed, with notes by the E on each, the square background was placed in the open space, and the S was now

asked, to, (b) (i), "select two harmonious figures and place them on this square in a pleasing arrangement." The composition of the S was then unobtrusively and quickly copied by the E on a previously prepared sheet of paper, the distances of the small figures from each other and from the sides were measured and noted. Then the S was asked to "make a composition with (ii) three forms", and then in turn (iii) "4 forms" and "(iv) 5 forms" always on the same background. After this, the series of 4 problems was repeated with (respectively) the rectangle, the triangle and the circle as background. For each problem in each series the Experimenter followed the same scheme: sketching the arrangement when completed, with measurements, taking notes as needed and so preparing on the spot as complete a record as possible. The S was always put at his ease and reassured as in the previous experiments that there are and can be no really right or wrong solutions for these problems which are purely a matter of personal taste which has nothing to do with either personality or intelligence. About one hour was required generally and on the average, for each S to complete the series comfortably.

40 Ss participated, 20 men and women, 36 of whom had already taken part in the previous experiments.

## 2. Experimental Results with Forms.

a. **First Series.** Statistical treatment of the results in the first section of the experiments with 51 small figures yielded a basis for discerning four main relationships:

1 — Form relationships between the background and the figures of the foreground. Designated (B).

2 — Form relationships of the small foreground figures with each other: Designated (F).

3 — Proportional relationships of the small figures with each other: (P).

4 — Form or pattern of the arrangement of the figures on the background: (A).

On careful scrutiny these four relationships were found to manifest several different characteristics under varying conditions. This finding reminds us of the results in Part One, the experiments with colors.

- 1 — Form relationships of foreground with background: (B)
  - a. Contrast-(K) Compositions made from foreground figures that contrast with the background.
  - b. Gradation-(g) Compositions where figures were just slightly different from the background form.
  - c. Similarity-(Sa) Foreground figures of the same form as the background.
  - d. Mixed-(Mix) Cases where the small figures contained combinations of K, G, Sa. (In Appendix, Table K, samples are given of figures accepted as K and G on each of the four backgrounds.)
- 2 — Form relationships of the small figures with each other. (F)
  - a. Contrast (K)
  - b. Gradation (g)
  - c. Similarity (Sa)
  - d. Mixed (Mix)
- 3 — Proportional relationships of the small figures. (P)
  - a. Contrast (K)
  - b. Gradation (g)
  - c. Similarity (Sa)
  - d. Mixed (Mix)
- 4 — Arrangement of the figures in relationship to each other on the background: (A)
  - a. Linear Arrangements:
    - i - Horizontal Symmetry (Sh)
    - ii - Vertical Symmetry (Sv)
    - iii - Diagonal Symmetry (Sd)
  - b. Balance achieved by the use of large areas of the background:
    - i — Formal balance (Fb); Arrangements made by using the same or almost the same forms, starting from the center and balancing towards the left, right, top and bottom.
    - ii — Informal balance (Ib); Arrangement of different forms on the ground space in a balanced pattern taking size into account.
    - iii — Radiation (R); illustrated by these figures:
    - iv — Random (r); Random placement of forms apparently without

taking any kind of order into account. Very few Ss used this sort of an arrangement.

Appendix, Tables V<sub>1</sub>—V<sub>17</sub> give the raw results of analysis into the above classificatory system. Table V (p. 49) gives for each group the frequencies of different compositions when all 4 factors are taken into account. Appendix, Table Va illustrates a number of compositions that show a frequency of more than one. But it may be noted that highest frequency was no more than 5. Appendix, Tables Vb<sub>1</sub>—Vb<sub>5</sub> shows the frequencies when each of the four factors is considered by itself. Appendix, Table Vc the most frequent examples are illustrated for each factor.

From these results we may conclude that:

1 — In the relationships of the small forms with the background contrast appears to be the most frequent factor. (K).

a. Along with obvious contrasts gradations made by the addition of a slightly varying figure or figures were also fairly frequent. (Kg, 2Kg, 3Kg).

b. The women Ss used gradations almost as frequently as contrasts for their compositions with three or four forms on the triangular background.

c. In the compositions made with five figures on the circular base the most frequent factor for all Ss seemed to be the mixed (Mix).

2 — In the relationships of the small figures to each other, gradations (g) emerge as the frequent.

a. Along with an obvious gradation contrasts were also used in some compositions. (2gK, 3gK, 4gK). Sometimes similar figures were used in addition to gradations. (2Sag, 3Sag, 4Sag).

b. Men Ss used contrast (K) somewhat more frequently than gradations for the two figure compositions on the triangular backgrounds.

3 — In the proportion relationships of the forms with each other, the most obvious factor was gradation (g).

4 — In all the arrangement of figures on the various backgrounds the most frequent factors emerging were vertical symmetry (Sv) and informal balance (Ib).

a. For the compositions containing two or three figures the Ss most frequently used vertical symmetry (Sv) in their arrangements.

b. For the compositions with four or five figures, the Ss most often used informal balance (Ib) in their arrangement.

c. Women Ss regularly used vertical balance in compositions with 4 or 5 figures on the triangular base. They used informal balance very frequently also for the compositions involving two or three figures on the rectangular base. Women Ss, in a few other problems deviated somewhat from the average trend, and showed a tendency to pay more attention to the shape of the base as compared to the Men.

#### b — The Second Series of Experiments with Forms.

The material for these series consisted of 510 small figures, and 4 gray backgrounds described above at the beginning of this section. (Part II) Here color was introduced as a definite factor. The previous experiments were now repeated with this additional factor added. The conditions and the Ss were all similar to those in the simple form experiments just described above. The analyses of results were also carried out as in the previous series, but of course, this time the color factor added additional categories.

Appendix, Tables VI<sub>1</sub>—VI<sub>17</sub> give the raw results of these experiments. Table VI, (p. 53): Here are shown the numbers of different compositions that each subject group made with all factors considered together. Appendix, Table Via, gives the frequencies of the compositions used more than once. The highest frequency comes out as no more than 3. Appendix, Table Vic, shows the frequencies for the several factors studied separately.

From these results we may conclude that:

1 — The most frequent factor in the relationships to each other of small colored figures is again found to be contrast (K).

a. On a triangle background in compositions with more than two figures, the Ss use gradations (g) more frequently than contrasts (K).

b. Women Ss, in their compositions with two or three figures on the circle background use gradations.

2 — In the relationships of colored forms with each other, the most frequent factor is apparently similarity. (Sa).

a. Along with similar figures, forms that show slight gradations are also used. (3Sag, 2Sag, 3SaK, 2SaK).

b. Men Ss use contrast most frequently for their compositions with two figures on the rectangle background as also for their compositions made without a background.

3 — Proportional relationship of small figures with each other reveal gradation (g) as the most frequent obvious factor.

4 — In arrangements on a background linear symmetry (S) and informal balance (lb) are more frequently used than any other type.

a. Men Ss generally use vertical symmetry (Sv) in their arrangements.

b. Women Ss generally use informal balance (lb) compared to the men, and, they once again show a tendency to consider the form of the background on which their arrangements are made, varying their compositions accordingly. Thus they use horizontal symmetry (Sh) on a rectangular base, and formal balance (Fb) on the triangle.

5 — Color relationships of the figures with each other, reveal in two figure compositions brightness contrast made by using an achromatic color with a chromatic color (AK). For the combinations with three or more figures, contrasts secured by using two neighboring chromatic colors with a contrasting chromatic color are the most frequent combinations:  $3C_{(K_1 + g_2)}$

### 3 — Summaries and Results.

The experiments made in these studies on suitability in visual perception were described, analyzed and discussed in three parts: First, using colored papers and colored pieces of cloth, the Ss were asked to make pleasing color combinations for different situations. Second, the Ss were asked to make pleasing combinations with simple figures on backgrounds of varying shapes. Third, the simple figures used in the Second Experimental Series were prepared in 10 different colors and compositions were arranged by the Ss on neutral colored backgrounds.

The results of Part One of the experiments and the comparison of these results with the other studies in this field, were given in detail at the end of that section. Here we may say in summary that, the lay Ss who had no special interest in art, used contrast as the most frequent factor to secure pleasing combinations of colors. This contrast was sometimes a brightness, sometimes a hue contrast. This had been previously found to be the case in simple combinations of two colors. Not as frequent as contrasts, were also instances of hue gradations. But, in combinations with three different hues, the Ss combined these two possibilities producing very harmonious compositions. They combined two neigh-

boring hues with a contrasting hue, or two neighboring hues with an achromatic color of contrasting brightness.

The compositions with forms were studied with respect to the factors involved. These factors were form relationships between the small figures and the background figures, the form relationships of the small figures to each other, the form of the arrangements of small figures on the background, the proportional relationships of the small figures to each other, and finally, when color relationships of small figures with each other were added, the color produced an additional fifth category.

In the form relationships between the background and the small figures, the most important factor was found to be contrast. This relationship was found to be valid throughout the experiments, whether black forms, or various colored forms were employed. In the form and proportional relationships of small figures with each other, the most frequent factor appeared to be gradation. Small figures that were not similar in shape and size, but enough different to make variations were used together to evoke and preserve the contrast effect. With color forms the Ss. used similar figures, the colors contrasting either in hue or brightness. Thus the contrast with the background was still preserved.

The arrangement of the figures showed an obvious symmetry along certain directional lines, horizontal, vertical, diagonal. Some asymmetrical balances were also achieved, mostly by women Ss.

In order to evaluate the results of these experiments thus shortly summarized, it would be worthwhile to glance at the ideas of the Gestalt Psychologists who had much to say on the subject of visual perception, and especially, on perception of forms. This school in psychology not only laid basic foundation stones of our knowledge in this field, but also right from the beginning, paid attention to art in their studies. It could hardly be a new idea for thoughtful artists and musicians who create pleasing effects and even masterpieces in forms, colors, or sounds, to know that a perceived whole is something more than and different from the sum of its parts. Von Ehrenfels, in the paper that was responsible for giving the Gestalt School its name, pointed to the differences between the sum total of the experiences of twelve different observers who each had listened to one of the twelve different tones of a melody, and a single observer who had listened to the melody as a whole.

In the perception of forms, the parts that form the whole are organized by the observer into a meaningful and integrated whole. The main principle of this organization lies in the relationships of the various fi-

figures to each other and to their backgrounds, and in many cases the clear contours of these figures on these backgrounds. The principle of the Gestaltists, for figures to have clear-cut contours set off from the backgrounds, in order to be perceived, has also proved to be valid with experiments made on Ss who having had congenital blindness, gained their eyesight after an operation. Senden, in 1932 showed to about 66 newly operated Ss simple forms like cubes, pyramids or balls, and as a result of his experiments found that these Ss were not at first able to name these forms as such, without touching them. Yet, they all without exception perceived a distinct figure other and different from the background.

When, in our experiments, the Ss were asked to make pleasing compositions with figures on several differing backgrounds of the same or other forms, it was interesting to find the Ss using contrasting relationships. In the first part of the experiments the color of the background figures was white, and the color of the small figures was black, hence there was already contour enough to insure the perception of the figures very easily. But, to this perceptual field, when the problem of suitability was added, it was then found that pleasing, harmonious relationships in such perceptions needed the factor of contrast between the figures in the foreground and those in the background.

In the opposite pole of this phenomena, that is in order to lose the perception of a figure, the contours of that figure needs to be eliminated by fitting or blending shape and/or the color and brightness of the figure or figures into the background. This is of course the principle of both natural and artificial camouflage. In reality, adaptation in nature and in life is brought about by fitness. Wild animals, insects, and birds show a great variety of perfect examples of this fitness. The insects with their protective coloring and forms fit extremely well into their usual environment, and the same is also true of many small birds in and out of their nests. In picture quizzes where some figures are hidden, the contours are always wholly concealed in the background, and in this way, their perceptions made extremely difficult.

According to the Gestalt theories, in order for figures to form a whole such factors as recency, sameness, continuity, and so on, are needed. The need to achieve a whole from parts is a first principle not only of perception but also of the arts. And, in order to bring about the wholeness, the mind tries to find certain relationships between the available objects. Similarly, in these experiments the Ss brought together slightly diver-

gent figures in order to achieve pleasing and agreeable Gestalts. When the factor of color was added to the material, the pleasing variability was produced by holding the shapes of the figures constant, while the colors of the forms were contrasted.

The figures in the experimental arrangements were generally organized according to some kind of a balance or symmetry. It is a known fact that, in works of art, unity is often achieved by balance and proportional relationships. Symmetry (as in the human form) is one of the first principles to be observed and learned. It is natural that mankind has used this symmetry in art and in invention. Primitive peoples especially utilize symmetry in their art work. Children's drawings also reveal an emphasis on symmetry, as long as they are not interfered with from without. But, balance is not, of course, achieved only through symmetry. In the experiments reported here our Ss, who did not have any training in art, in order to balance the figures pleasantly, used symmetry very frequently. But also some other balances were brought into the picture by using sometimes informally balanced arrangements.

As a result of our experiments we may say that, in the field of visual perception pleasing arrangements and suitability are best achieved by contrast. Perfect adaptation means fitting the background perfectly, thus losing individual identity. Individuality was evidenced by our Ss in differing either little or more from each other in some of their compositions, but nevertheless, showing a certain tendency as a group, when confronted with a problem of suitability in visual perception, even though they were never trained along any of the fields of fine arts.