THE FORM-COLOR PREFERENCES OF 2 1/2-, 3 1/2,-AND 4 1/2-YEAR-OLDS

Thesis for the Degree of Ph. D.
MICHIGAN STATE UNIVERSITY
PHYLLIS E. LUECK
1969

This is to certify that the

thesis entitled

THE FORM-COLOR PREFERENCES OF

21/2, 31/2, AND 41/2 YEAR-OLDS

presented by

PHYLLIS E. LUECK

has been accepted towards fulfillment
of the requirements for

PH.D. degree in EDUCATION

Lee S. Shulman

Date AUGUST 15, 1969

O-169

ABSTRACT

The primary purpose of this investigation was to re-evaluate two early studies which had become classics. The one had shown that young children shifted their preference for form at age two years to color at age four (Brian and Goodenough). The other had revealed that the type of form was a significant factor in the choice of form or color by young children (Descoudres). The secondary purpose was to gather qualitative data which would explain the results within Piaget's model of the growth of thought during the pre-operational period.

It was hypothesized that 2½-year-olds would prefer form rather than color more often than 3½-year-olds who would prefer form more often than 4½-year-olds. It was also hypothesized that more preferences for form would be made with realistic figures than with modified abstract forms, likewise, more with modified forms than with geometric shapes.

Consideration was given to the possible biasing effects of experimenters (Rosenthal). Three experimenters administered the tests, one knew the expected outcomes and the other two did not. Differences between sexes were not expected.

Phyllis E. Lueck

Three groups of 36 middle-class children, half boys and half girls, from Lansing, Michigan participated in the study. The groups ranged in age from 2:4 to 2:8 years, from 3:4 to 3:8 years, and 4:4 to 4:8 years.

Three form-color type tests of nine items each were administered to each child. After the tests were completed the child was asked to attempt to label the forms and colors and to verbalize their awareness of the similarities between objects.

The results contradict the earlier finding that children prefer form at age two years and color at age four. In this study almost half of the children preferred color on all three tests, while the number who preferred form increased with age. Those who showed mixed preferences decreased with age on all tests. Secondly, the findings did not support the hypothesis that predicted the type of form would be pertinent to a child's preference. The choices for form or color were consistent across tests.

Statistical analyses did not reveal a significant difference among the experimenters, however, a strong possibility exists that experimenter effects were influential upon the distribution of scores on the test with the modified forms. Also, these young subjects continually sought reinforcement from the experimenters so that subtle communication of the experimenter's biases was probably made.

While no differences between the sexes was expected, 37 boys and 12 girls at the 2½ year level were eliminated from the study when they were unable to complete the tests.

Descriptive data showed evidence of Piaget's concept of centration and decentration. Some children hesitated before indicating their preferences, some indicated an awareness of both dimensions of form and color, while a few others shifted their preferences from one dimension to the other during the testing.

It was concluded that the major findings from both of the early studies with children from 2½ to 4½ years were no longer useful. Children at age two do not prefer form to color only to shift to color at age four, nor do they prefer form with realistic forms and color with geometric forms.

THE FORM-COLOR PREFERENCES OF 2 1/2-, 3 1/2-, and 4 1/2-YEAR-OLDS

by

Phyllis E. Lueck

A THESIS

Submitted To
Michigan State University
In Partial Fulfillment of the Requirements
For The Degree Of

DOCTOR OF PHILOSOPHY

College of Education

1969

ACKNOWLEDGEMENT

The writer wishes to express her deepest gratitude to her committee: Dr. Lee Shulman, Dr. Maryellen McSweeney, Dr. Ellen Strommen, and Dr. Ann Olmsted for their assistance and support from the beginning to the end of this project. To Dr. Shulman, her adviser, who so generously shared his profound knowledge, the writer is especially appreciative.

The writer is indeed grateful to Dr. Clark Moustakas for the invaluable encouragement he furnished at very critical times.

The unfaltering enthusiasm of Martha Serig and Sue Simmons in testing the young children contributed much toward the quality of the study.

The writer also wishes to express her appreciation to all the children and parents for the splendid cooperation they gave to the study.

The enduring friendships of Josephine Keltner during these five years of graduate study is remembered.

And, finally, the writer is also very appreciative of the never ending support of her mother, Erna Lueck, her sister, Erma Stewart, and the other Stewarts, Harold and Tom.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

In the literature on the intellectual development of children from birth to maturity, a scarcity of information exists concerning the period from age two to four years. A perusal of the recent developmental research abstracts reveals a paucity of investigations using this age group. Even on the theoretical level, this is the least investigated period by Jean Piaget within the whole span of intellectual and perceptual development which he studies (Flavell, 1963, p. 150).

One of the classic studies using this age group, as well as the succeeding years, is that of Brian and Goodenough (1929) in which developmental shifts were demonstrated with relation to preference for form or color. Using the technique of matching form (plane and solid geometric) or color (bright and saturated), the data showed that between the ages of 2:0 to 2:6, a high percentage of the choices were made on the basis of form, while with the age group of 4:0 to 4:6, almost the same high percentage of choices were made on the basis of color. By the age of six years, form again became the dominating factor (p. 212).

These results as well as those of Katz and Descoudres (to be discussed later) have been used rather extensively by developmentalists to formulate generalizations about the thinking of young children. For example, in discussing "the analogous processes of abstraction," Werner (1940) proposed

> It may be that for younger children objects are "things-of-action" (e.g., "graspable objects"), and therefore their most impressive dynamic properties--that is, the forms--are stressed rather than the colors. And it may also be that at a somewhat later age colors come to the fore because, at a stage at which things are not so rigidly defined by motor behavior, they have a greater emotional appeal than form, whereas, at a still more advanced, realistic level, form again supplants color as a superior distinguishing quality of things (p. 237).

In his chapter on perceptual and cognitive development, Ausubel (1958) also used the findings from the Brian and Goodenough study as the base for his supposition that "apparently both the very young and the older child prefer a functional to a descriptive basis of classification once fascination with vivid descriptive categories declines (p. 561)."

Sigel (1964) cited all three studies in his treatment of "the attainment of concepts" with the results of the Brian and Goodenough study suggesting to him that

> It may be more adaptive for children to deal with objects on the basis of form. The comprehension of permanence may come about just because of form saliency. Further, if the children during the preschool period are orientated toward objects on a topological basis, it would appear that form is a salient criterion in differentiating the environment. This may explain the dominance of form (pp. 230-31).

The present investigator contended that the Brian and Goodenough experiment with the youngest group of children needed to be re-evaluated and a new study conducted for several reasons. First, the study was 40 years old, and an assumption might be made that the preferences of very young children for form or color might be different today. Second, the very youngest subjects exhibited "a strong tendency toward perseveration of response." Half of the choices with surface forms were perseverative and were "disregarded" in the treatment of the data. Third, they state that "in the case of the very little children it was quite evident that the verbal instructions had been very imperfectly comprehended (p. 201)." Their instructions were "See these two pretty blocks? And see this other one? Now which of the two blocks up here is just like this one? (p. 199)."

As a consequence, this investigator undertook to study a group of two-and-one-half, three-and-one-half, and four-and-one-half-year-old children using geometric, modified, and realistic forms in order to attempt to discover whether a developmental shift in preference from form to color was still evident. Another purpose of this study was to find whether the preference for form or color was consistent irrespective of the meaningfulness of the forms. The third purpose was to endeavor to explain the results

within Jean Piaget's theoretical model of the growth of thought during the preoperational period.

CHAPTER II

REVIEW OF LITERATURE

Prior to the Brian and Goodenough investigation Descoudres (1914) had studied 3- to 6-year-olds' choices of form or color with plane geometric (i.e., circle, diamond, triangle, and square) and common (i.e., pot, basket, bottle, lamp) shapes. The data revealed that form was preferred with the latter, while the reverse was true with the geometric shapes. No significant difference was found between the sexes. Still earlier in 1913, Katz (reported in Stern, 1930) in a similar study with geometric forms, found that children up to the age of 4;8 years made their selections on the basis of color usually. The youngest subjects with whom his test had "a positive result" were 2;9 years. Thus, while neither investigation revealed an early preference for form, Brian and Goodenough's subjects who preferred form were much younger. Their sample ranged in age from 1;2 to 3;6 years.

Since the Brian and Goodenough study, the question of young children's preference for form or color has been investigated up to the present using a variety of dimensions. Corah (1964) studied the young child's mode of matching perceptual stimuli on the basis of color and form with a

population from 3:10 to 5:8 years. Supporting the earlier studies, his results demonstrated that young children match on the basis of color with no consistent sex differences. Interestingly enough, Corah's test involved three types of figures: asymmetric, colored geometric forms; line drawings of simple forms (e.g., circle, rectangle) with line detail inside the figure; and outlined, asymmetric forms. For a theoretical base, Corah felt that Piaget's concepts of centration and decentration seemed to offer the most adequate framework for his results.

More recently Corah (1966) studied the effects of the amount of surface color in the stimuli and the complexity of the stimulus forms with six groups of preschool Ss and six groups of 7- to 9-year-olds. His first set of stimuli were the usual geometric forms, in the second set the comparison figure of the same color was not a different figure but one similar to the standard, and in the third set the comparison of the same color was "readily discriminable" from the standard in shape. In order to test for the effects of the amount of surface color, one subset had all solidly colored forms while in the other, all forms were only outlined in color. His findings gave evidence that in two of the three comparisons between the solidly colored forms and the outlined in color forms, a significantly greater number of color choices were made to solidly colored forms. In addition, even though a significantly greater

number of color responses were obtained from the preschool Ss than from the older Ss, five of the six groups of preschool Ss were form dominant. This seemed to suggest to Corah that preschool children no longer respond to geometric figures in terms of color to the extent which they formerly did.

Kagan and Lemkin (1961) failed to find the traditional developmental differences with a group of children ranging in age from 3:9 to 8:6 years. All of the children seemed to prefer form to color or size. This study has been criticized because the term "cutout" was used in the instructions and critics felt that the instructions produced a set that emphasized form.

In still another study with kindergarten children, Corah and Gross (1967) investigated the variables of hue, brightness and saturation in color-form matching. They found that "brightness differences produced a significantly greater number of color matches than did either hue or saturation differences (p. 140)."

Since 1929 color-form preferences of young children in other countries have also been investigated. In 1930 Rabello (reported in Kidd and Rivoire, 1966) found that with Bolivian children of 3 to 11 years, color preferences decreased with age while form choices increased. Engel (1935) studied German children whose ages ranged from 2 to 11 years and his data revealed that children under 3 1/2 years were nearly unanimous in their classification according to form. With those between 3 1/2 and 6 years a very high percentage classified according to color. His methods of

investigation were similar to those of Katz.

Kindergarten children in China, age 3 to 6 years, composed Huang's (1945) sample. The results of his experiment gave evidence that with color differences held constant, the proportion of form choices increased as form differences between the choice objects increased, e.g., a square was matched with a rectangle that approached a square, or in another set, with one that was long and narrow. And when form differences were held constant, color choices increased as the color differences between the choice objects increased. In an attempt to investigate their form difference, he found that "real things do not seem to have a very unequivocal advantage over their wooden replicas in favoring form choices (p. 62)."

Lastly, Suchman (1966) investigated the color vs. form preference of Moslem Hausa children in Zaria, Nigeria, West Africa. Age was not a variable. In preference among her Ss (age 3 to 15 years), there was no trend toward form preference. Thus, she feels that in terms of developmental theory, "the concept of a universal maturational process in perceptual color-form preference must be modified if not abandoned (p. 7)." In her analysis of individual differences, most of the children showed a unidimensional preference either for color or form.

Other experiments have approached the problem not from differences in age of the subject but rather from individual differences. When Colby and Robertson (1942) set

out to examine the distribution and stability of color-form response within a group, age 3 1/2 to 9 1/2 years, over a developmental period of one year, they discovered that the pure form-dominant children exceeded the pure color-dominant children by a small margin. After a retest a year later when the individual records were analyzed longitudinally, three rather distinct types appeared: "a stable type, either pure form or pure color dominant, which did not change; a mixed type, which changed predominately toward form; and a very unstable type, which showed uncertain and marginal preferences throughout (p. 391)." Within the preschool group on the initial test, form dominance exceeded color dominance by 12 per cent.

In another study Suchman and Trabasso (1966) found that a very high percentage of their Ss were unidimensional and consistent in their color-form preferences despite stimulus variation, e.g., hue, saturation, form, and contour. Where the ages ranged from 2:10 to 6:6 years, the younger children generally preferred color and older children generally preferred form with the median transition age at 4:2 years. Children with mixed preferences were evenly scattered throughout the groups.

And so, over the period of the past 40 years, the Brian and Goodenough study has become a classic, and no subsequent research has tended to refute the findings. It is accepted that with young children, generally, form is more attractive than color up to the age of 3 years, but that

during the span from 3 to 6 years color is preferred. Accordingly, it was hypothesized that on a task in which the choice is between matching for form or for color, but not both, 2 1/2-year-olds would make significantly more form responses than 3 1/2-year-olds who would make significantly more form responses than 4 1/2-year-olds.

An earlier study by Descoudres, using the same ambiguous problem, revealed that young children (3 to 6 years) matched most often on the basis of color with geometric forms, but when realistic shapes were used there was a dominance of form responses. Thus, in order to investigate the attribute of form more thoroughly, 3 tests were devised: Geometric, Realistic, and Modified. For the Modified Test the present investigator attempted to design some figures which might be considered midway on a continuum if geometric shapes were at one end and realistic shapes at the other. Hence, it was hypothesized that the frequency of responses for form on the Realistic Test is significantly greater than on the Modified Test, and that the frequency of responses for form on the Modified Test is significantly greater than on the Geometric Test.

In only one instance (Corah's) has the experimenter attempted to explain his results using Piaget's theoretical framework, i.e., the characteristic of centration. One of the most pronounced characteristics of preoperational thought of the young child is his tendency to "center," i.e.,

to give attention to a single salient feature of an object while disregarding others. Flavell states that "the child is unable to decenter, i.e., to take into account features which could balance and compensate for the distorting, biasing effects of the single centration (9, p. 157)." Corah interpreted deliberation of the older children before making their choices as the onset of decentration.

Finally, consideration was given to Rosenthal's (1966) finding of "experimenter effects," i.e., the experimenter himself may be a significant determinant of the results of his research. What he is discussing is very much like Merton's concept of "self-fulfilling prophecy" whereby one prophesies an event (i.e., an experimental result) and the expectation of it then changes the prophet's (experimenter's) behavior in such a way as to make the predicted event more likely. In one experiment where Es were not permitted to speak other than the standard instructions, the conclusion was made that the communication of E's biases had been by some subtle paralinguistic (e.g., tone) or kinesic (e.g., facial expressions, gestures) signals (1964, p. 94). The author and two female graduate students in child development administered the tests. The graduate students were unaware of the hypotheses of the study and were asked to refrain from doing any reading on the topic. Comparisons of the three experimenters would be made in order to ascertain whether significant differences existed.

And although no significant differences between the sexes within this age range had been shown in other studies, the effect of sex would be tested.

In summary, Table 1 presents the pertinent facts of the studies which are germane to the present experiment.

TABLE I

Summary of Studies Reviewed

Investigator	Year	Ages of Ss	Sample Sizes	Findings
Katz	1913	2;9 to 4;8 years	?	Matching based predominately on color with geometric figures.
Descoudres	1914	3 to 6	60	Children matched most often on basis of color with geometric figures but on form with realistic figures.
Brian and Goodenough	1929	1;2 to 5;11	219	Using plane and solid geometric forms children at two years preferred form, shifted to color at age 4 1/2 years and back to form at 6 years.
Rabello	1930	3 to 11	?	Color preferences decreased with age while form preferences increased.
Engel	1935	2 to 11	800	Children under 3;6 years showed an almost exclusive interest in form, then shifted to color.
Colby & Robertson	1942	3;6 to 9;1	138	In the preschool group form-dominance exceeds that of color-dominance. Pure form-dominant children exceeded the pure color-dominant by 10 per cent.

TABLE I-Continued

Investigator	Year	Ages of Ss	Sample Sizes	Findings
Huang	1945	Kindergarten	20	With plane and solid geometrical figures and plane figures of real things, form choices dominated. Real things do not have an advantage over their wooden replicas in favoring form choices.
Kagan and Lemkin	1961	3:9 to 8:6	69	All children strongly preferred form to color or size. Criticized for using "cutouts" in the instructions.
Corah	1964	3:10 to 5:8	80	Hypothesis confirmed that amount of color and complexity of stimuli was related to level of color response.
Corah	1966	3:2 to 5:8	210	Hypothesis confirmed that amount of color and complexity of stimuli was related to level of color response.
Suchman and Trabasso	1966	2:9 to 6:6	166	Younger children mostly preferred color while older preferred form with median transition age at 4:2. Most of Ss were unidimensional and consistent.
Suchman	1966	3 to 15	120	With West African children 3 to 5 1/2 years 85 percent of the choices were for color. Most of the Ss had a unidimensional preference.

TABLE I-Continued

Investigator	Year	Ages of Ss	Sample Sizes	Findings
Corah and Gross	1967	5:0 to 7:1	240	The form alternative differed from the standard and color alternative in hue, brightness, and saturation. Brightness differences produced a significantly greater number of color matches.

CHAPTER III

METHOD

Statement of Hypotheses:

A. Two-and-a-half-year-olds make significantly more form responses than 3 1/2-year-olds who make significantly more form responses than 4 1/2-year-olds. (2 1/2 > 3 1/2 > 4 1/2).

B. The frequency of responses for form on the Realistic Test is significantly greater than on the Modified Test. The frequency of responses for form on the Modified Test is significantly greater than on the Geometric Test.

Sample

The subjects consisted of three groups of 36 children each, half boys and half girls. The first group ranged in age from 2:4 to 2:8 years, the second from 3:4 to 3:8 years, and the third from 4:4 to 4:8 years. Only those subjects who did not attend a weekday nursery school were selected. Many nursery school curricula tend to place much emphasis upon learning to name colors and shapes, and the experimenter wanted to avoid the influence of recent learning upon the test results as much as possible.

Since very few 2 1/2-year-olds attend preschool this added another dimension toward the homogeneity of the group.

The subjects represented an essentially middle-class population judging from their housing and area of residence. Children were located through Protestant churches and Catholic schools in the area of Lansing, Michigan. The former provided lists of young children enrolled in their Sunday Schools and the latter passed out and returned a voluntary sign-up sheet, which had been prepared by the experimenter. Parents contacted by these means often suggested children of friends and neighbors who fitted into the age ranges of this study.

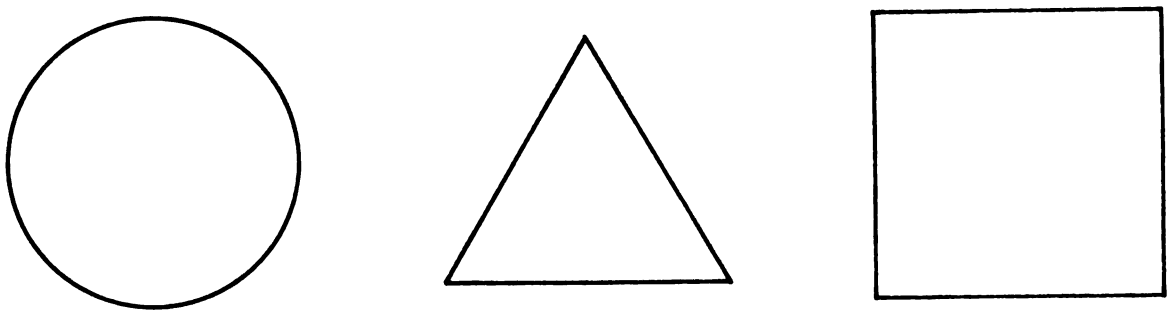
Materials

Three sets of stimulus figures in three colors, red and blue and yellow, were employed. The primary colors were chosen since they were used in the majority of previous studies. The three sets of stimulus figures differed in the type of forms represented. One set consisted of geometric forms, the second set consisted of modified forms, and the third realistic forms (shown in Figure 1). The geometric and modified forms were cut from glazed paper of bright color and mounted on heavy white cardboard. A transparent adhesive plastic was used as a protective covering. The realistic forms were brightly enameled, raised (3/8 inch) wooden figures which were cemented to the plastic covered white cardboard.

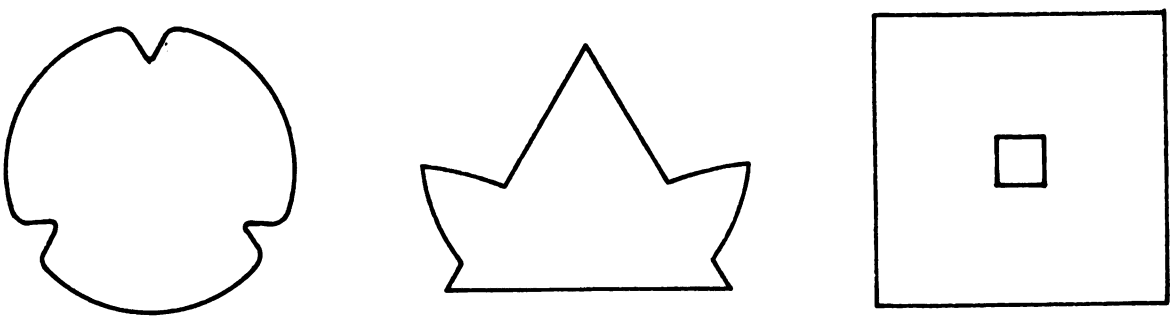
Tests corresponding to each of the three types of form cues were constructed. Each test consisted of nine items. An item consisted of a standard form mounted on a 2 1/2 x 2 1/2 inch card, and the comparison form mounted on a 2 1/2 x 10 inch card. The comparison figures were mounted six inches apart with one matching the standard in color but not in form, while the other matched in form but not in color. Each form was used as a standard three times, once in each of the three colors, and as a comparison figure six times, twice in each of the colors. Children were given all three form-color type tests, making a total of 27 items per child.

Procedure

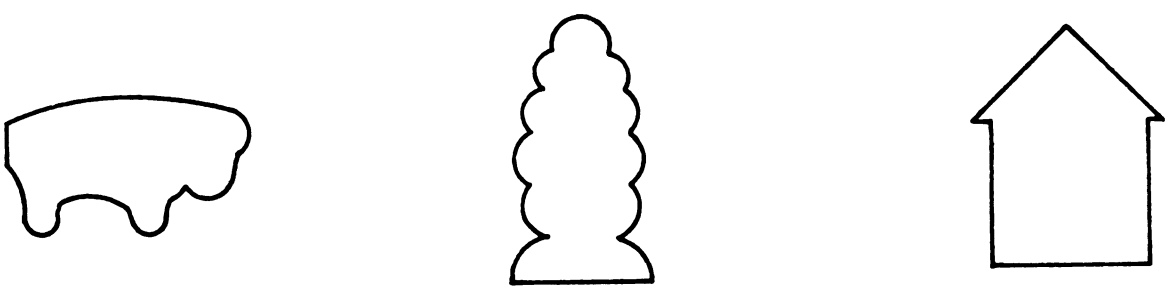
The testing was done in each child's home with time allowed to establish rapport. If after approximately 10 minutes the child refused to participate, the session was terminated. Six boys, age 2 1/2 years, were unwilling to participate. The principal investigator and two female graduate students in child development each tested 12 children, half boys and half girls, in each group for a total of 36. The graduate students had been trained in testing procedure by the principal investigator through observational and practical experiences. The E provided a child-size table with two small chairs, which were placed as far as possible from any distractors. The test materials were kept out of sight of S in a box which was on a stool to the right



GEOMETRIC FORMS (actual size)



MODIFIED FORMS (actual size)



REALISTIC FORMS (actual size)

FIG. 1. Three Types of Test Forms

of E. In almost all cases the E and S were in a room alone, but when a mother expressed a strong desire to observe the testing she was asked to sit behind the child.

After S was seated opposite E at the table, a short pretest was given using different forms (e.g., rectangle, heart, giraffe) and different colors (e.g., orange, pink, green) from those appearing in the test objects. In this pretest, the Ss were required to match for identical objects, e.g., objects which matched on both form and color. In order to forestall a position preference in the actual testing, the matching figure was rotated from left to right and top to bottom. Those children who were unable to match at least the last five of the eight items on the pretest were eliminated from the study. Three boys and one girl in the 3 1/2-year-olds were dropped for this reason, and 37 boys and 12 girls in the 2 1/2-year group were eliminated from the sample after showing an initial willingness to participate. Most of these children seemed unable to understand the requirements of the test, e.g., they would point to the standard, place the standard in the center of the comparison card, take the standard card away and then hand it back to E, or leave their chair in the middle of the testing. Therefore, the subjects in the 2 1/2-year group tend to be a highly selective sample; the boys especially are probably more mature than the average.

For the actual testing, the comparison cards were placed face down in a stack in front of E. The standard cards were held in E's left hand. Then E put the comparison card in front of S so that the figures were at his left and right and said, "Look at both." Next, holding the standard card about four inches above the table and about 12 inches from S, the experimenter said, "Find this one, find one like this." The child indicated his preference by pointing to the matching figure on the comparison card or by placing the standard card on or beside it. The standard card was then removed to E's lap and the comparison card moved close to E on the left or right side of E on the floor to be recorded on the score sheet after the session ended. The total testing time was about 10 minutes.

The position for form matches in relation to the child followed the sequence R, L, R, L, L, R, R, R, L in each test. Two sequences of the tests (i.e., GMR and RMG) were selected as representative of the six possible sequences and were randomly assigned among the subjects (Winer, 1962, p. 352).

After the tests were administered the child was asked a variety of questions in an attempt to gain some insights into the young child's thinking. Each S was asked to select from the nine standard cards of the geometric test the colors named by E. He was requested to label the forms and then the colors. Finally, S was shown two standard

cards matched according to his general preference form or color and asked, "Can these go together? Why?" or "Are these alike? Are they the same? Why?" Then the opposite match was shown to S and the same questions asked. The questions were intended to test the limits of the child's choices. Piaget, for example, believes that the clinical method, i.e., the employment of many "rephrased" questions, is the only way to get to the child's cognitive structure (Flavell, p. 28).

Scoring

A score of "1" was given for each item indicated by the child as a preference for form. A score of "0" was given for each item matched by color. Thus, the test scores on each test ranged from "0", all color responses, to "9," all form responses.

Design and Analysis

The original design of the study was that of a 2 x 3 x 3 x 3 analysis of variance with repeated measures. The independent variables were age of children (three levels--fixed effects), examiners (three levels--fixed effects), sex of children (two levels--fixed effects), and type of test (three levels--fixed effects). The dependent variable was the number of form responses for each child to each test. In this design repeated measures, tests of different types, were administered to the same child.

The main effect for age and the main effect for type of test was to be tested using the Greenhouse and Geisser procedure (Winer, 1962). If either effect was significant at the .05 level, then a posteriori tests using the Scheffé method were to be made to test the specific hypotheses of order and linear trend (ibid., p. 88).

However, because of the characteristics of the obtained score distributions, data were analyzed using non-parametric techniques (Chi-square) rather than an analysis of variance. This point is discussed in the next section.

CHAPTER IV

RESULTS

In order to use an analysis of variance technique for analyzing the data, the assumption is made that the sample was drawn from a normally distributed population. Figure 2 shows that with this particular sample, the distributions of scores on the Geometric, Modified, and Realistic Test were J- or U-shaped. About one-third of the sample at ages 2 1/2 and 3 1/2 years preferred color exclusively on each of the tests, while the converse was shown with the 4 1/2-year-olds on the Geometric and Modified Tests. About equal numbers of 4 1/2-year-olds showed exclusive preference for form and color on the Realistic Test. Table 2 presents the means and standard deviations for the 2 1/2-, 3 1/2, and 4 1/2-year-olds on the three tests.

TABLE 2

Means and Standard Deviations of the Tests According to Age Groups

Type	2 1/2 years		3 1/2 years		4 1/2 years	
	Means	S.D.	Means	S.D.	Means	S.D.
Geometric	3.5	3.35	3.3	3.60	5.1	3.78
Modified	3.3	3.47	3.5	3.80	4.6	4.02
Realistic	3.1	3.01	3.6	3.72	4.9	4.03

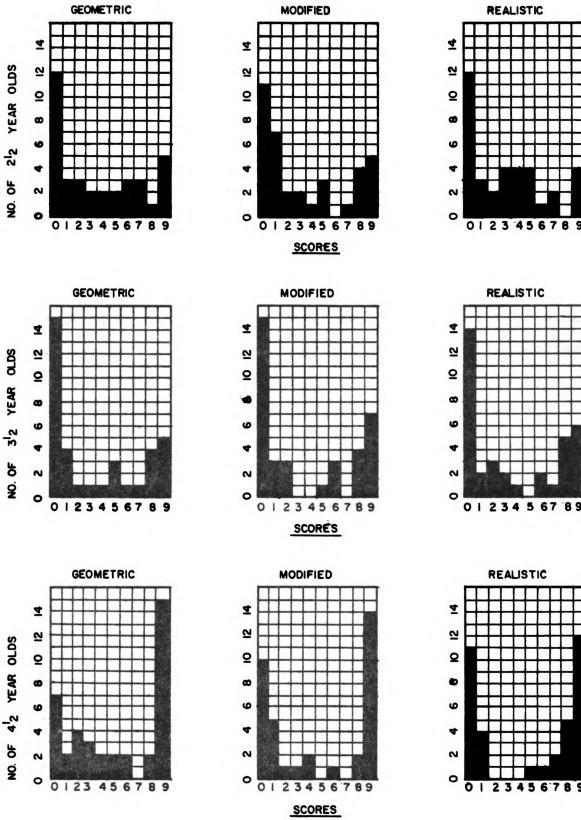

GEOMETRIC
MODIFIED
REALISTIC
NO. OF 2½ YEAR OLDS
NO. OF 3½ YEAR OLDS
NO. OF 4½ YEAR OLDS
0 2 4 6 8 10 12 14
0 1 2 3 4 5 6 7 8 9
SCORES

FIG. 2

Here again the fact that the scores were widely dispersed is demonstrated clearly. And so, since these distributions deviate markedly from normal distributions, the data were analyzed by Chi-square, a non-parametric statistic.

A Chi-square Test for Homogeneity was used to compare the dimension preference for 2 1/2-, 3 1/2-, and 4 1/2-year-olds on each of the three tests (Hays, 1963). Scores were categorized for dimension preference as follows: if a subject scored zero or one on a test he was a color preferrer, if two through seven a mixed preferrer, and if eight or nine a form preferrer. Table 3 presents the observed frequencies of the dimension preference for each age group according to the type of test. Significant differences were found for the Geometric and Realistic Tests ($p = .05$) indicating that color, form, and mixed preferences do not have the same distributions at different ages. Inspection of Figure 2 and Table 3 suggests that (1) about half of the subjects consistently preferred color at all ages and on all tests, (2) form preferences increase with age on all tests, and (3) mixed preferences decrease with age on all tests. On the basis of these data, the first hypothesis of the study must be rejected. The number of form choices increased from 2 1/2 to 4 1/2 years, rather than decreased as was predicted, whereas the number of color choices did not change with age, but were quite strong at each of the ages tested. Using total test score categories, Table 4 also shows the increase

TABLE 3

Comparison of Score Distributions for 2 1/2-, 3 1/2-, 4 1/2-Year-Olds

	Color (0-1)	Mixed (2-7)	Form (8-9)	Total
Geometric				
2 1/2 Years	15	15	6	36
3 1/2 Years	19	8	9	36
4 1/2 Years	9	10	17	36
Totals	43	33	32	108
Modified				
2 1/2 Years	18	9	9	36
3 1/2 Years	18	7	11	36
4 1/2 Years	15	5	16	36
Totals	51	21	36	108
Realistic				
2 1/2 Years	15	17	4	36
3 1/2 Years	16	9	11	36
4 1/2 Years	15	4	17	36
Totals	46	30	32	108

Geometric Test: X^2; $X^2 = 11.4$ with 4 df; $p = .03$. Results significant at .05 level.

Modified Test: X^2; $X^2 = 3.66$ with 4 df; $p = .50$. Not significant at .05 level.

Realistic Test: X^2; $X^2 = 16.64$ with 4 df; $p = .01$. Results significant at .05 level.

TABLE 4

Number of Choices for Form, Mixed, or Color Preferences at Each Age Across All Three Tests

Preference	2 1/2	3 1/2	4 1/2	Total
Form (0-1)	19	31	50	100
Mixed (2-7)	41	24	19	84
Color (8-9)	48	53	39	140
Total	108	108	108	324

in the number of choices showing preference for form from the youngest to the oldest age group. Again, the number of mixed choices decreased with age, while the number of color choices remained about the same. A Chi-square test could not be done on the frequencies of form, mixed, and color choices at each age level for all three tests. The reason is that each child is represented by three scores so that the required assumption of independence is not met.

In order to examine the relationships among the groups Large Sample Post Hoc Procedures for the Chi-square Test of Homogeneity were used (Marascuilo, 1966). The results revealed that on the Realistic Test the 2 1/2-year-old mixed and form preferrers. No other differences were found to be significant in the post hoc analysis.

Another way of looking at the data was by individual differences. Each child was categorized according to his total score, i.e., he was categorized as a color preferrer

if his total score ranged between 0 and 3, a mixed preferrer if between 4 and 23, and a form preferrer if between 24 and 27. A Chi-square Test for Homogeneity was used to compare the dimension preference for each age group on the total test scores. The results confirm that the three age groups do not have the same score distributions (see Table 5). No significant differences were found in the relationships among the groups in the post hoc analysis.

TABLE 5

Comparison of Total Score Distributions for 2 1/2-, 3 1/2- and 4 1/2-Year-Olds

	Color (0-3)	Mixed (4-23)	Form (24-27)	Total
2 1/2 years	14	17	5	36
3 1/2 years	15	14	7	36
4 1/2 years	10	11	15	36
Total	39	42	27	108

Age Groups: X^2; $X^2 = 8.58$ with 4 df; $p = .07$.

Percentages for the group collapsed across ages were figured by summing each score according to the type of test and dividing by the total possible score (all choices made on the basis of form). Examination of Table 6 shows that the percentages of choices for form and color appear relatively stable across tests. Thus, the second hypothesis that

TABLE 6

Percentages of Choices for Form or Color

Type	No. of Ss	Form	Color
Geometric	108	44 per cent	56 per cent
Modified	108	42	58
Realistic	108	43	57

the frequency of responses for form with realistic figures is equal to those with modified figures which is equal to those with geometric figures, cannot be rejected.

Another way of looking at the data was by correlations between tests. Table 7 shows that relatively high intercorrelations were obtained. Collapsing across age groups the correlation between total scores on the Geometric

TABLE 7

Correlations Between Tests According to Age Groups

	2 1/2	3 1/2	4 1/2
G with M	.86	.93	.83
G with R	.74	.82	.72
M with R	.83	.84	.92

Test and the Modified Test was .88, between the Geometric Test and the Realistic Test was .77, and between the Modified Test and the Realistic Test was .87. Clearly, the type of

form did not appear to be a significant factor in a child's preference.

No differences between the sexes were expected. Again a comparison of the percentages of choices for form or color according to sex was quite similar (see Table 8).

TABLE 8

Percentages of Choices for Form or Color According to Sex

Sex	No. of Ss	Form	Color
Boys	54	45 per cent	55 per cent
Girls	54	42	58
Total	108		

Of the three examiners who conducted the study one was familiar with the hypotheses and the other two were not. To determine whether familiarity significantly influenced the results, the data were analyzed by experimenters. Table 9 presents the results of this analysis of score distributions on the three tests by experimenters. The results show no significant experimenter effects, although the distribution of scores for the modified test reflects the strong possibility of some influence due to experimenters. The strong biasing effects that had been found in Rosenthal's experiments were not clearly apparent in this study, although some trend in this direction was observed.

TABLE 9

Comparison of Score Distributions by Experimenters

	Color (0-1)	Mixed (2-7)	Form (8-9)	Total
Geometric:				
E-1	16	11	9	36
E-2	14	11	11	36
E-3	13	11	12	36
Total	43	33	32	108
Modified:				
E-1	17	9	9	36
E-2	20	9	11	36
E-3	15	3	16	36
Total	52	21	36	108
Realistic:				
E-1	17	10	9	36
E-2	16	7	13	36
E-3	13	13	10	36
Total	46	30	32	108

Geometric Test: X^2: X^2 = .76 with 4 df; p= .95. Not significant at .05 level.

Modified Test: X^2: X^2= 7.6 with 4 df; p= .10. Not significant at .05 level.

Realistic Test: X^2: X^2 = 3.18 with 4 df; p= .50. Not significant at .05 level.

Qualitative data were collected in this experiment in an attempt to find evidence of Piaget's concept of centration and decentration. The experimenters observed the same hesitation by some children before making their choices that was reported by Corah. However, in the present experiment the standard card was manipulable so that other indications of beginning decentration were also noted. Eleven of the children from the two older groups placed the smaller card beside each figure on the comparison card before making their choices. Six of them verbalized the ambiguity of the task, e.g., "this is a round one like this one, but it's blue like this one." One boy 4 1/2 years showed his frustration with the ambiguity by frowning and sighing. He scored a four, five, and four.

Another reaction by three children was to choose one variable and then switch to the other so that they had scores of zero, four, and nine; one, zero, and nine; and eight, zero, and zero. After matching all the items on the pretest a 2 1/2 year-old boy looked at the first geometric standard card, studied the comparison card, returned his attention to the standard, and then said, "Hey! Where'd it go?" One might speculate that perhaps he had a beginning awareness of the two aspects of the stimulus. Finally, the experimenters observed at least six children engrossed in the tests with their attention focused on the cards, making unidimensional choices, suddenly place the card on the alternative, and look up at the experimenter for a reaction.

The questions did not elicit much additional information. Most of the children in the upper age groups were able to name the colors. Seven of the youngest children who chose by color exclusively were unable either to name or to point to the colors. To the question about why the two objects went together (were alike), the responses generally fell in three categories: "because", "I don't know", or no response. The most timely opportunities for asking pertinent questions were lost because they arose during the formal testing sessions.

To summarize, the distributions of scores on the three tests were J- or U-shaped. The first hypothesis that form choices decreased with age was rejected. The data revealed that color was preferred by nearly half of the subjects at all ages on all tests, the number of form choices increased with age on all tests, and the number of children who showed no distinct preference decreased with age on all tests. The type of form on the tests did not appear to make a difference in the children's choices, so that the predicted shift to a majority of form choices with the realistic figures was not found. No differences between the sexes on form-color choices were revealed. Statistical analyses did not disclose any significant experimenter effects. Finally, descriptive data showed evidence of Piaget's concept of centration and decentration. The interpretation of these results will be discussed in the next section.

CHAPTER V

DISCUSSION AND CONCLUSIONS

The data from this study failed to substantiate the Brian and Goodenough finding that children below the age of three strongly prefer form and then shift to color by 4 1/2 years. Rather color preferences were equally strong at all ages and form preferences increased with age. Figure 2 showed that in the present investigation the 2 1/2-year-olds preferred color whereas the 4 1/2-year-olds chose form more often. Careful examination of Brian and Goodenough's study raises questions about their sample, their method of administering the test, and their procedures for scoring. In the first place the data were collected from college laboratory preschools at the University of Minnesota and the State University of Iowa in the spring and summer of 1927 and again at the former nursery school and at several day care centers in Minneapolis the following spring in 1928. The children from the laboratory nursery schools were probably from faculty families which are usually very academically oriented. In 1928 children who were placed in day care centers were usually from indigent families. In the nomenclature of today these would be deprived children. We know that today there is a vast difference in many areas of development between

these two groups so that pooling the data together makes one skeptical of the true meaning of the results. Therefore, the writer questions the representativeness of the sample from which such widespread generalizations have been made.

Next, the method of administering the tests, the first set a series of solid geometrical forms and the second a series of surface forms, does not seem reasonable. Only the solid forms were used with the 76 children who were tested in 1927, while both the solid and surface forms were used with the 143 tested in 1928. Twenty of the children were included in both groups. An opportunity for a longitudinal study with these children was not taken. The procedure of allowing 20 children to contribute two scores to the overall set lessens the value of the results in the opinion of the writer.

Another criticism against Brian and Goodenough's study was the omission of a pretest with such very young children when the instructions were so meager. And yet no mention was made of any child being eliminated from the study. Eighteen of the subjects were under two years, the youngest 14 months. In the present study the proportion of 2 1/2-year-old boys who were unable to perform the task was about one in every three, for instance. This finding leads one to question the validity of the results with the youngest children.

Still another point of objection concerns the lack of attention paid to sequence effect. The order of testing with the second group was always the solid forms first and

then the surface forms. An effort was made in the present study to control for sequence effects but due to the size of the sample for analyzing the data, only two sequences out of the six possible were used. The Modified Test was always presented between the other two which were rotated. Significance was not revealed in a comparison of score distributions by age groups with the Modified Test. Perhaps the greater variability in the scores on the first and last test could be due to a slight confusion at the beginning or to fatigue or boredom at the end of the testing session. Some children tried experimenting when they became aware of the second dimension of the objects.

Next, the writer is very critical of the manner in which the "perseverative" responses were disregarded by the early experimenters. The test items were set up so that for the first two the comparison figures remained the same but the standard changed. Brian and Goodenough state that the very young child was likely to choose the same block or figure on the second trial that he had on the first. They felt that the choice was based on "individual interest" or pure chance so they were not included in the analysis of the data. The percentages of "perseverative" choices were 61 per cent on surfaces with those children under two, 40 per cent with those between 24 and 30 months, and 50 per cent with those between 30 and 36 months. This type of manipulation of the data is unacceptable for research today.

A more careful scrutiny of the results causes this writer to believe that this study has outlived its usefulness. The final conclusions were based on an average of less than five responses per child with the surface figures in a sample of 16 under two years. The 25 children who were between two and three years averaged between six and seven responses out of the possible twelve items with the surface forms. The present study had 36 children, ages 2:4 to 2:8 years, who responded to 27 surface form items. Forty-nine children within this age range were eliminated from this study for reasons mentioned earlier.

Finally, Rosenthal has recently made us aware of the biasing effects of an experimenter. The experimenter's sex, race, religion, status, likeability, and warmth are all variables which have been found to make a difference. Prior acquaintance with subjects, adjustment, hostility, anxiety, acquiescence, authoritarianism, and intelligence all have been shown to affect subjects' responses. Since the experimenter in the Brian and Goodenough study said, "See these two pretty blocks?" one might assume that warmth and friendliness were shown toward the children rather than a more objective attitude. No information was given about the experimenters. The present writer is aware of the number of times the subjects in her study attempted to elicit reinforcement from the experimenters, e.g., searching the experimenter's face for cues, asking, "Is that right?" All of

these factors cast serious doubt in the mind of the writer whether the Brian and Goodenough findings have relevance for understanding the growth and development of young children in today's world.

The second hypothesis for the study investigated the effect of the type of test on the choices for form or color. Descoudres in 1914 found that with realistic objects children from three to six years made more form choices but the reverse was true with geometric shapes. In the present study the percentages of choices for form and color remained relatively stable across tests. Again, examining the procedures very carefully one notes that Descoudres' comparison card had four different shapes in each of two colors for a total of eight. Similarly, no pretest was given, but during the testing session itself training took place. If S placed the standard card on one of the figures which did not match in form or shape, the E would make the child start over until he was able to place the card on one of the matching forms or colors. Descoudres states that she insisted on "plusieurs" retakes which may be translated as "some," "many," or "several." One might speculate that the subjects were forced to exhibit some consistency through this procedure.

Her results are given in percentages which show that 69 per cent of the group's choices were by color with the geometric forms and only 38.5 per cent with the familiar shapes. There was only one percentage point of difference

between the two tests in the present investigation. Perhaps in 1914 young children were not exposed to much training in regard to shapes so that color was the more salient dimension with the geometric shapes. This may not have been true with the familiar figures. Many of the mothers in the present investigation would tell the experimenter that the child had been taught the names of the shapes. One of the oldest Ss talked to the experimenter about trapezoids.

The present investigator is puzzled about the results with the Modified Test. The figures were an innovation with the study. They were hypothesized to be about midway between a geometric shape and a realistic shape. The questioning brought forth such realistic labels as flower, apple, cloud, and funny cookie for the modified circle; king's hat predominantly for the modified triangle; and house, window, television, projector, and flag for the modified square. Eighteen of the children labeled both the geometric and modified forms as squares, but not a single child responded to the modified triangle as an abstract form. Three children replied that both figures were circles, another that both were round, while one reported that the geometric form was a "round circle" and the modified "a round circle with little bumps." Thus, it appeared that children within the upper age range of this study gave the figures in the Modified Test either abstract or realistic labels with no midpoint between.

The fact remains that a comparison of the score distributions for the three age groups was not significant with the Modified Test whereas the other two were. When a comparison was made of the score distributions according to experimenters, significance was almost approached. The fact that the test was always the second of three has been discussed. Very close examination of the total scores on the Modified Test according to experimenters reveals a wide discrepancy of almost fifty points, i.e., the total scores were 120, 122, and 171. This great difference was not shown with the other tests. It is conceivable that this experimenter effect, more than any other factor, may be the reason for the difference.

An examination of the relationships among the groups disclosed that the number of color preferrers at each age level was quite a consistent amount. At the 2 1/2-year level a substantial number had scores in the mixed category with a small group who preferred form. In contrast to this the number of children at 4 1/2 years who were form preferrers had increased to a substantial amount while the number in the mixed preference category diminished. Thus, the shift was not from form to color but rather from a mixed preference to a form preference with those children who did not choose color almost exclusively. This seems to be in agreement with the Colby and Robertson study where the same children were retested a year later, and they found that their mixed type changed predominately toward form.

In accord with previous studies no sex differences were found in statistical analyses. However, the fact that 37 boys against 12 girls at age 2 1/2 years were unable to be tested discloses a difference.

Descriptive evidence was presented which was interpreted as indicating that while many children seemed to be unaware of the ambiguity of the task or to use Piaget's term, seemed to center their attention on only one aspect of the objects, others indicated that they had an awareness of both color and the form of the objects, or were beginning to decentrate. Piaget has theorized that children are not able to decentrate in a functional way until age seven.

To summarize, the writer feels that in view of the findings of this study the concept that most children at age 2 1/2 years prefer form is no longer tenable. Controls for age, type of test, experimenter effects, and sex were included in the study. The age range within groups was limited to four months. The results showed that 2 1/2- and 3 1/2-year-olds preferred color on all three tests. The 4 1/2-year-olds preferred form on the Geometric while an almost equal number preferred either form or color exclusively on the Modified and Realistic Tests. The number of children who showed mixed preferences at 2 1/2 years shifted to form preferences at 4 1/2 years.

The percentages of choices for form or color according to the type of test was relatively stable. Therefore, the finding of Descoudres over fifty years ago that the type

of shape made a difference in a young child's preference no longer seems to be sound.

Since knowledge of expected outcome may influence the results, three experimenters administered the tests in order to test for such biasing effects. There was no evidence of such an effect through statistical analyses. However, the writer suspects that experimenter effects contributed much of the difference between the Modified Test and the other two. Also, the experimenters became very aware of how often young children sought reinforcement cues. This needs to be followed up more carefully in subsequent research with children in their early years.

Finally, no sex differences were expected nor did they appear to be shown in this study with the hard data. However, at the 2 1/2-year level boys appeared to be very different from girls in their ability to be tested with the form-color matching tests of the study.

Descriptive evidence was presented which indicated that while many of the Ss centered on only one dimension of the objects, others showed that they were beginning to decentrate, to use Piaget's terminology, or in other words were beginning to show a simultaneous awareness of both form and color.

It is concluded that young children at age two-and-a-half do not prefer form nor do they prefer color at age four-and-a-half years. The evidence that did appear was

that some children in each age group and on all tests preferred form while others preferred color. It is further concluded that the older children did not prefer color with the geometric shapes nor form with the realistic objects. The results do not confirm the findings of the Brian and Goodenough study whereby a developmental shift from form to color was demonstrated with children between two and four years. The results also contradict the findings of Descoudres who found that shape influenced young children's choices for form or color.

The findings of the investigation suggest three problems for further study. The fact that so many of the Ss tended to be unidimensional was unexpected. Honkavaara (1958) found that children and adults who tended to react predominantly with color orientation were more perceptive and sensitive to other people while form reactors tended to be more practical, realistic, and socially conforming. Thinking in terms of individual differences, how else do they differ in personality? Longer longitudinal studies need to be made than the one year study of Colby and Robertson. How consistent is a preference for form or color after five or ten years? Would a preference for form or color be indicative of the type of vocation for which an individual might be fitted at a later date?

Next, a study of the changes in preoperational thought and the characteristics of the movement from

centration to decentration in these early years is needed. What are some of the stages? Is a child able to decentrate on form and color sooner than on height and width, for instance? Can decentration be taught? Is a child able to learn to read before he is able to focus his attention on more than one dimension of an object?

And finally, the writer suggests a study of the family milieu of 2 1/2-year-old boys as compared with 2 1/2-year-old girls. What kinds of expectations does our culture have for boys? For girls? What kinds of training is given to girls that is not given to boys generally? Does being the youngest or oldest child make a difference? And as a follow-up study would these same boys be ready for the formal instruction of first grade at age six?

One implication for education that this study seems to point out is the need for more attention to individual differences. The fact that some of the children at age 3 1/2 years were beginning to show signs of a mental process which Piaget says is not functional until age 7 makes the writer feel that individual performances vary widely in many ways. Age seems to be less meaningful all the time as a way of making judgments about a child's level of development, and yet many important decisions continue to be made using this as a basis.

REFERENCES

1. Ausubel, D.P. Theory and Problems of Child Development. New York: Grune & Stratton. 1958.

2. Brian, Clara R. & Goodenough, Florence L. "Relative Potency of Color and Form Perception at Various Ages." J. Exp. Psychol., 1929, 12, 197-213.

3. Colby, Martha G. and Robertson, Jean B. "Genetic Studies in Abstraction." J. comp. Psychol., 1942, 33, 385-401.

4. Corah, N. L. "Color and Form in Children's Perceptual Behavior." Percept. Mot. Skills, 1964, 18, 313-316.

5. Corah, N. L. "The Influence of Some Stimulus Characteristics on Color and Form Perception in Nursery-School Children." Child Develpm., 1966, 37, 205-211.

6. Corah, N. L. and Gross, J. B. "Hue, Brightness, and Saturation Variables in Color-Form Matching." Child Develpm., 1967, 38, 137-142.

7. Descoudres, Alice. "Couleur, forme, ou nombre?" Arch. Psychol., 1914, 14, 305-341.

8. Engel, P. "Uber dic Teilinhaltliche Beachtung von Farber und Form; Untersuchung an 800 Schulkindern." Zeitschrift Padagog. Psychol., 1935, 36, 202-214. 241-251.

9. Flavell, J. H. Developmental Psychology of Jean Piaget. Princeton, N.J.: Van Nostrand, 1963.

10. Hays, W.L. Statistics for Psychologists. New York: Holt, Rinehart, and Winston, 1963.

11. Honkavaara, S. "A Critical Reevaluation of the Color and Form Reaction, and Disproviding of the Hypotheses Connected with it. J. Psychol., 1958, 45, 25-36.

12. Huang, I. "Abstraction of Form and Color in Children as a Function of the Stimulus Objects." J. genet. Psychol., 1945, 66, 59-62.

13. Kagan, J. and Lemkin, Judith. "Form, Color and Size in Children's Conceptual Behavior." Child Develpm., 1961, 32, 25-28.

14. Marascuilo, L. A. "Large Sample Multiple Comparisons." Psychol. Bul., 1966, 64, 280-290.

15. Piaget, J. Judgement and Reasoning in the Child. New York: Harcourt, Brace, 1950.

16. Piaget, J. The Psychology of Intelligence. New York: Harcourt, Brace, 1950.

17. Piaget, J. Play, Dreams and Imitation in Childhood, New York: Norton, 1951.

18. Rivoire, Jeanne L. & Kidd, Aline H. "The Development of Perception of Color, Space, and Movement in Children." In A. H. Kidd & J. L. Rivoire (Eds.), Perceptual Development in Children. New York: International Universities Press, 1966.

19. Rosenthal, R. "The Effect of the Experimenter on the Results of Psychological Research." In B. A. Maher (Ed.), Progress in Experimental Personality Research. Vol. I. New York: Academic Press, 1964.

20. Rosenthal, R. Experimenter Effects in Behavioral Research. New York: Appleton, Century, Crofts, 1966.

21. Sigel, I. "The Attainment of Concepts in Children." In M. L. Hoffman & Lois W. Hoffman (Eds.), Review of Child Development Research. Vol. I. New York: Russell Sage Foundation, 1964.

22. Stern, W. Psychology of Early Childhood. New York: Holt, 1930.

23. Suchman, Rosslyn G. "Cultural Differences in Children's Color and Form Preferences." J. Soc. Psychol., 1966, 70, 3-10.

24. Suchman, Rosslyn G. and Trabasso, T. "Color and Form Preference in Young Children." J. exp. ch. Psychol., 1966, 3, 177-187.

25. Werner, H. Comparative Psychology of Mental Development. New York: International Universities, 1948.

26. Winer, B. J. Statistical Principles in Experimental Design. New York: McGraw-Hill, 1962.