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FINAL REPORT ON HEAD START EVALUATION AND RESEARCH--1966-67 TO THE INSTITUTE FOR EDUCATIONAL DEVELOPMENT. SECTION VII, SENSORY AND PERCEPTUAL STUDIES.

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THREE STUDIES OF PRESCHOOL CHILDREN ARE INCLUDED IN THIS EVALUATION REPORT. (1) "'NEURAL CONDUCTIVITY' AND ACHIEVEMENT IN CULTURALLY DEPRIVED STUDENTS." NEURAL CONDUCTIVITY WAS INFERRED FROM A CORRELATION BETWEEN PUPILLARY RESPONSE AND CHILDREN'S PRESCHOOL PERFORMANCE. COMPLICATIONS IN ACQUIRING AND USING THE NECESSARY EQUIPMENT RESULTED IN THE AVAILABILITY OF ONLY 7 SUBJECTS AND INSUFFICIENT DATA FOR ANALYSIS. (2) "STIMULUS PREFERENCE AMONG CHILDREN OF DIFFERENT ETHNIC BACKGROUNDS." PREFERENCE FOR COLOR OR FORM, SYMMETRICAL OR ASYMMETRICAL DIMENSIONS WAS TESTED WITH CHILDREN OF NEGRO, INDIAN, AND ANGLO BACKGROUNDS. SUBJECTS WERE SHOWN 40 1-FOOT-SQUARE CARDS, EACH WITH 3 STIMULI ARRANGED IN A TRIANGLE, AND ASKED TO MAKE SELECTIONS. RESULTS SHOWED THAT PERSONALITY VARIABLES AND SOCIALIZATION INFLUENCES AFFECTED STIMULUS PREFERENCE, WITH CHILDREN FROM A CERTAIN CULTURAL BACKGROUND GENERALLY PREFERRING THE SAME STIMULI. (3) "A PERCEPTUAL COMPONENT OF VISUAL-ANALYTIC SKILLS." A TACHISTOSCOPE WAS USED FOR CHILDREN TO VIEW DRAWINGS OF CLASSROOM OBJECTS AND TO INDICATE RECOGNITION BY IDENTIFYING THE ACTUAL OBJECTS. A VISUAL-ANALYTIC SKILLS TEST, DEVELOPED FOR THE EXPERIMENT, WAS USED AS A CRITERION INSTRUMENT OF FORM PERCEPTION ACCURACY. THE EXPERIMENTAL TREATMENT WAS INEFFECTIVE IN PRODUCING VISUAL DISCRIMINATION ACCURACY GAINS OVER AN 8- TO 10-WEEK PERIOD. (MS)

FINAL REPORT ON

HEAD START EVALUATION AND RESEARCH: 1966-67

(Contract No. 66-1)

TO

THE INSTITUTE FOR EDUCATIONAL DEVELOPMENT

By

The Staff and Study Directors

CHILD DEVELOPMENT EVALUATION AND RESEARCH CENTER

John Pierce-Jones, Ph.D., Director

The University of Texas at Austin

August 31, 1967

Section VII: Sensory and Perceptual Studies

A. "Neural Conductivity" and Achievement in Culturally Deprived Preschool Children, by David S. Holmes

B. Stimulus Preference Among Children of Different Ethnic Backgrounds, by Charles M. Spellman

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"NEURAL CONDUCTIVITY" AND ACHIEVEMENT IN CULTURALLY DEPRIVED PRESCHOOL STUDENTS

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The present research project was designed to evaluate the relationship between neural conductivity, as inferred from a pupillary response, and the performance of children participating in a preschool program.

Krech and his colleagues have published a series of articles relating brain chemistry to differences in learning performance in the rat (Rosenzweig, Krech, & Bennett, 1958, 1960, 1961). The primary concern in these reports was with acetylcholine (ACh) which is the transmitter substance at the cholinergic synapses in the brain. Their data indicated that higher levels of ACh were associated with better learning performance. The work of these researchers was, unfortunately, limited to animals because there were no techniques available for taking the physiological measures on human beings. Recently, Rubin (1960, 1964) introduced a pupillary response measure which he indicated was an index of the level of the cholinegric transmitter substance available, i.e., acetylcholine. He pointed out that the speed of pupillary constriction was a good measure because "the magnitude of constriction is an increasing monotonic function of the amount of the cholinergic mediator liberated" (Rubin, 1964, p. 567). That is, greater constriction is indicative of greater amounts of ACh at cholinergic synapses. Since transmission of the neural impulse is dependent upon sufficient quantities of the transmitter substance, the pupillary response may be an indirect measure of what might be called the potential "efficiency" of neural transmission. Subjects with faster constriction might be said to have a higher level of "neural conductivity."

Holmes (1967a), using Rubin's measure, reported that subjects with faster speeds of pupillary constriction were significantly more likely to become aware of the reinforcement contingency in a verbal conditioning task, i.e., solve the implicit problem posed for them, then evidence significantly better conditioning performance. Further, the speed of pupillary constriction was significantly related to introverted personality characteristics. In a recent pilot study, Holmes (1966) found that the speed of pupillary constriction was related to the performance of college students on two types of problem solving tasks. Lastly, to add to the "nomological net" relating the pupillary response to cortical conductivity, it has been shown (Holmes, 1967) that differences in the duration of the figural aftermovement have an effect, one which has long been considered to be a function of neural conductivity.

Method

Apparatus and Tests

The apparatus used to measure the pupillary response was completely enclosed in a black box which measures 12" x 14" x 12". The outside of the box was plain with the exception of the front. The front of the box had a 4.5" circular hole. Mounted over this hole was a rubber face mask against which the subject placed his face when he looked into the box. Contained within the box was 1) a 16mm. Bolex motion picture camera, 2) a motor to drive the camera, 3) a transformer to convert the AC current to DC since the motor operated on DC, 4) a small 25 watt electric light bulb, and 5) a delay circuit which controlled the length of time between the beginning of the camera's operation and the onset of the light. The instruments used were the Preschool Inventory (Caldwell & Soule) and the Stanford-Binet Intelligence Test.

Procedure

Each subject placed his face against the face mask so that he was looking into the darkened box and his eyes were not exposed to any light. After 30 seconds, during which the pupils of his eyes dilated, the experimenter threw the switch which started the camera. After 1.5 seconds, the light which served as a stimulus to constrict the subject's pupils came on. The camera and light were on for about 15 seconds during which time the subject continued to keep his face in the face mask and look at the lens of the camera. It was during this time that the pupillary response was photographically recorded. The film was then developed and the size of the pupil in every third frame was measured. Using this data, the proposition of constriction completed by each subject after one second was determined.

<u>Subjects</u>

It was originally planned to use a large number of subjects in this experiment. Two unforeseen problems arose which made wide sampling impossible. First of all, it was very difficult to obtain some of the apparatus needed to make the pupillary measurements. While the apparatus was ordered in November of 1966, it did not arrive until February of 1967. Some of the relays were then found to be defective and had to be replaced which required more time. Because of these delays, the appartus was not completely functional until late April. At this time some test measurements were taken and the second problem arose. It was discovered that because of the extremely dark pigmentation of the Negroid eyes, it was virtually impossible to distinguish the pupil from the iris on black and white film. (Previous research by the present author had been carried out on only Caucasian subjects whose eyes were not as heavily pigmented.) It was therefore necessary to change to color film, a change which introduced other problems since color film usually requires more light. If the light intensity was increased in the present apparatus however, the subjects would not have been able to keep their eyes open, and it would therefore have been impossible to take the measurements. After some experimentation, however, a special film was found which could be used with the required low level of tungsten light (Ektachrome, EF, type 7242). The preliminary tests with this film were completed one day before the schools closed for the summer. On the last day of school, the eyes of 40 students were photographed, seven of which were those who had been included in the general evaluation sample on which the various pre and post tests had been carried out.

Results

Because of the small number of subjects, most statistical tests would be inappropriate, and therefore means and distributions will be presented and examined for consistent trends. For the various comparisons, the seven subjects were divided into two groups on the basis of the speed of pupillary constriction in the first second. The first group (N = 4) consisted of those subjects who evidenced the fastest constriction while the second group (N = 3) consisted of those subjects who evidenced the slowest constriction.

Since with such a small sample means could be greatly affected by one extreme subject, the distributions will be presented. For these, the sample will be dichotomously divided into high and low groups on the dependent variable. On the basis of the previous results, it would be predicted that the group with the faster constriction would show higher test performance than that of the slow contriction group.

Pupillary Response and Age

This is essentially a control comparison to determine whether age per se might be effecting the pupillary response to some degree.

Mean Age In Months: Fast constrictors = 73.5
Slow constrictors = 71.3

	Fast	Slow
Older	2	2
Younger	2	1

It seems quite clear that ages are not related to the speed of pupillary constriction.

Pupillary Response and Performance on the Preschool Inventory (Pre-Test)

Mean Total Percentage Score: Fast constrictors = 59.2
Slow constrictors = 43.3

	Fast	Slow
High Score	3	1
Low Score	1	2

There is a difference of 15.9 percentage points between the two groups, but it should be noted that a large part of the mean difference is due to one slow constricting subject who had an extremely low score. However, when the general distribution is considered in the two by two table, the results are still consistent with the prediction that the subjects with faster constriction would evidence superior performance.

<u>Pupillary Response and IQ Measurement</u>

Mean IQ (<u>Stanford-Binet</u>): Fast constrictors = 89
Slow constrictors = 78

	Fast	Slow
High Score	2	2
Low Score	2	1

While again the mean scores are in the predicted direction, a large part of the difference is attributable to one of the slow constricting subjects, and, as can be seen from the two by two table, when the scores are dichotomized the results are equivocal.

Discussion

Due to the difficulties with the apparatus which resulted in the extremely small sample, it is impossible to draw any conclusions from the present data. Some of the results verge on being "suggestive of trends" consistent with the hypothesis but unfortunately this is the most that can be said at the present time. This experiment has provided a promising pilot study and should be pursued in the following year.

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STIMULUS PREFERENCE AMONG CHILDREN OF DIFFERENT ETHNIC BACKGROUNDS

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Introduction

When a five year old child perceives an object, which dimension of the object will be most relevant to his characteristic manner of perception? Usually, the meaningfulness of the object will be most relevant to him, but if that dimension is removed and an ambiguous stimulus field is presented, what aspect will he prefer? Form, color, or size? Is his preferred stimulus dimension characteristic of children of his same ethnic background? Or, is mental age the crucial variable which determines whether he will prefer form over color and size? Another pertinent question has to do with the effects of classroom learning on stimulus preference: are there shifts in preference in the first year of school?

These are questions dealt with in this study. Its purpose has been to explore young children's stimulus preferences for form, color and size. Of particular interest in this study are (1) the effects of different cultural backgrounds on the Ss' stimulus preference, and (2) the effects of eight months of schooling on a child's stimulus preference.

Previous Findings

The literature yields two main explanations to account for a child's stimulus preference.

Cognitive Maturation

Past studies have suggested that the development of conceptual thinking is a step by step process. It has been maintained that a child first learns to deal with color because it is easier to handle, and later on changes to form as he develops cognitively. Brian and Goodenough (1929) offer an explanation of this characteristic shift. They reason that when the child first begins to develop concepts, the abstractions are of the genus rather than the species type. All men become "daddy", and so forth. In making these early differentiations and classifications, form is of primary importance and color can be ignored. A rose is a rose regardless of its color. After the child has developed some facility in making these gross genus classifications (at about age 3), color becomes an important factor in making species classifications within a particular genus. A brown dog is very different from a yellow dog at this age. Later (age 6 to maturity), there is a gradual shift back to form as the most potent factor because children (1) have mastered the fundamentals of genus and species classifications and (2) have found that form classifications are generally more appropriate and effective than color in their psychological adjustments to their environment. Brian and Goodenough's results are graphed in Figure 1.

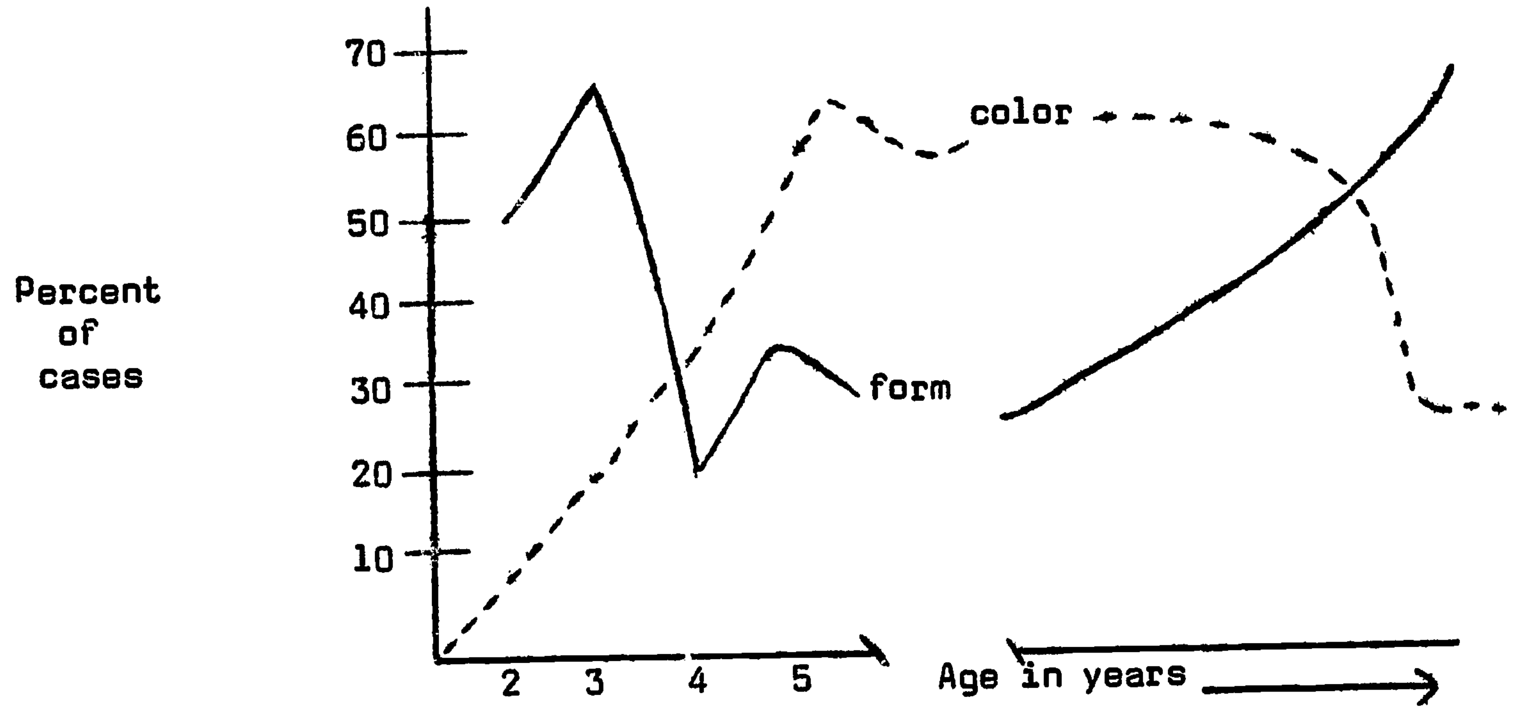


Figure 1

More recently Corah (1966) finds that significantly more color responses came from preschool children than from older children. Other studies show a decrease in average preference for color over form with age (e.g., Corah, 1964, Colby & Robertson, 1942). Generally, the transition from color to form preference has been regarded as a correlate of cognitive development by many persons in the area.

<u>Perceptual Style</u>

A different viewpoint has been espoused by Honkavaara (1958). She maintains that particular preferences for color or form reflect basic personality orientation and even goes so far as to propose psychotherapeutic programs which take into account the color or form reactivity of the individual. In contrast to earlier hypotheses regarding cognitive development, she finds that children of lower IQ were often form reactors. Using mostly adult Ss she finds that those who tend to react predominantly with color-orientation are more perceptive and sensitive to other people. On the other hand, form reactors tend to be more realistic, practical, and socially conforming. Also, sex differences are reported: women tend to prefer form. Similar sex differences are also found by Kagan & Lemkin (1961).

Proponents of this latter explanation of stimulus preference (which here is labeled perceptual style) may also quote the users of the Rorschach Ink Blot Test, who usually interpret color responses as indicating expressions of emotionality (Schactel, 1958).

The two prevalent viewpoints, the older one being that stimulus preference is a correlate of cognitive growth, and the more recent being that stimulus preference is a favored manner of perception, have been given to explain differences in stimulus preference. The first has usually been studied by testing groups of Ss at different ages. Nearly always it has been reported that with age there develops an enduring preference for form over color.

The second viewpoint has been best stated by Honkavaara who reports that her results reveal two basic types of personality: form-oriented and color-oriented persons. The possibility of such a notion is reinforced by Suchman's findings in Nigeria that practically her entire native sample preferred color at all ages through late adolescence. She does not test adults.

With these two viewpoints in mind, a study has been initiated to test for stimulus preference among American children of different cultural backgrounds.

Stimulus Preference of Project Head Start Ss

Exploratory work has been done recently with 5-year old culturally deprived children (defined by the poverty guidelines set forth by the Office of Economic Opportunity) from different cultural backgrounds. Preferences for form, color, and size have been investigated.

Method

The instrument is similar to a method used by Suchman and Trabasso (1966). The main difference is that their figures were projected on a screen whereas the present figures are presented on one-foot-square cards.

There are 40 cards, each with three stimuli arranged in a triangle. Specifically, there are four colors used, red (saturated & unsaturated), and blue (saturated & unsaturated). This is done in order to see if the Ss can deal with saturated colors more easily than nonsaturated colors. Four geometric forms are used: circle and rectangle (symmetrical), and trapezoid and bean (asymmetrical).

It should be noted that although there are 40 cards, a maximum preference score for any dimension is only 32. For instance, if a

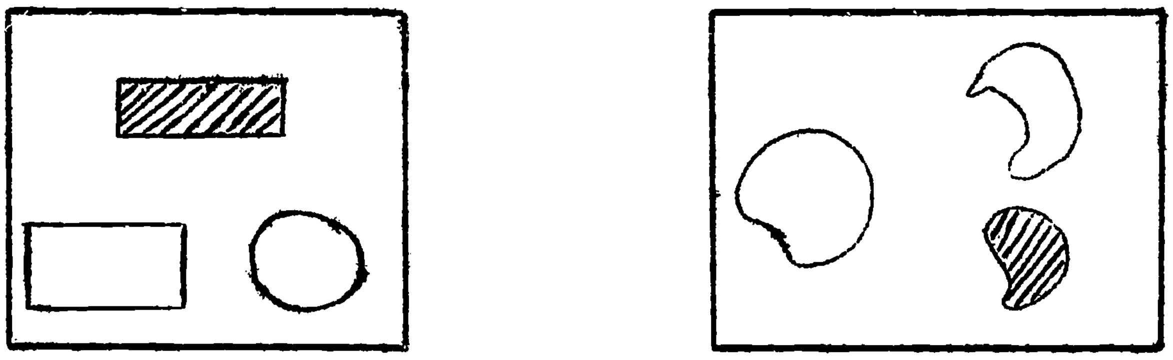
Table 1

Description of Cards For Testing Dimensional Preferences

	Form, Color, Size	Form, Color	Form, Size	Color, Size	
Saturated Symmetrical	4	2	2	2	
Saturated Asymmetrical	4	2	2	2	
Unsaturated Symmetrical	4	2	2	2	
Unsaturated Asymmetrical	4	2	2	2	
	16	8	8	8	40

Figure 2

Examples of Two Cards



Color, form, and size are varied.

Color and size are varied and form is constant.

S wishes to choose form each time he will find that on eight cards form is not a variable, and he will be forced to choose either color or size as the relevant dimension. The cards are arranged randomly and presented one at a time. The first card shown has all three dimensions present, and E tells the S: "Do you see this card? It has three things on it. Look at them carefully and point to the two that look most alike to you." At no time does E make any response to the S's choice. If the S persists in asking if he is choosing the correct one, he is told that he is "doing fine." Very few Ss do not understand what is expected of them. Those making more than three errors are eliminated. An error consists of a matching that clearly does not make sense, i.e., the two chosen stimuli are in no way alike.

Subjects

As already stated, the Ss were students in Head Start classes from four different centers. Table 2 offers a fuller description of the Ss.

Table 2

Description of Ss

Center	Cultural Bkgrd.	Mean CA	Mean MA	N
Oklahoma	Anglo	64.5	62.9	16
"	Negro	66.5	58.8	16
"	Indian	64.9	55.7	17
Utah	Anglo	59.1	59.5	26
"	Spanish	60.2	60.3	12
Arizona	Indian	65.9	60.0	50
New Mexico	Mex.-Amer.	65.2	56.7	31
Total				168

Results of Initial Testing

Initially 49 Ss, representing three cultural backgrounds, were tested in October, 1966 at the Anadarko, Oklahoma Head Start Center. The results are shown in Tables 3 and 4.

Table 3

PROBABILITY RESULTS, USING T TEST BETWEEN MEANS

GROUP	FORM	COLOR	SIZE
Negro and Indian	.07	.05	.05
Negro and Anglo	<.01	.01	.01
Anglo and Indian	NS	NS	.05

Table 4

X^2 TEST OF SIGNIFICANCE FOR GROUP PREFERENCE OF COLOR OR FORM, 1 df.

GROUP	FORM	COLOR
Anglo	6.04*	-
Indian	NS	NS
Negro	-	24.4*

*p = .02
**p = <.01

Results

Nearly all Ss were unidimensional in preference: 83 per cent selected twice as many of one dimension as they did of any other. It should be noted that the results were based on averages. Thus, in the first testing, Indians as a group were neutral in thoir preferences as measured by a Chi-square test of significance. But 83 per cent of the Indians were unidimensional, preferring one dimension twice as much as any other. It so happened that as many Indians were unidimensional with regard to color as to form, and the average score presented a picture of neutrality of preference.

Although there were significant differences in preference for size, the small number of size responses precludes any serious comment. The specific categories of symmetrical vs. asymmetrical form and saturated vs. unsaturated colors did not seem to make any difference. Perhaps they were not different enough.

In November of 1966 a sample of 31 Mexican-American Ss from Carlsbad, New Mexico were tested; in January, 50 Indians from the Pima-Maricopa Reservation in Arizona were tested; and in February of 1967 the test was administered to 26 Anglos and 12 Spanish Ss from Salt Lake City, Utah. Statistically significant differences were again found between Ss of different cultural backgrounds. These results are shown in Figures 3 and 4.

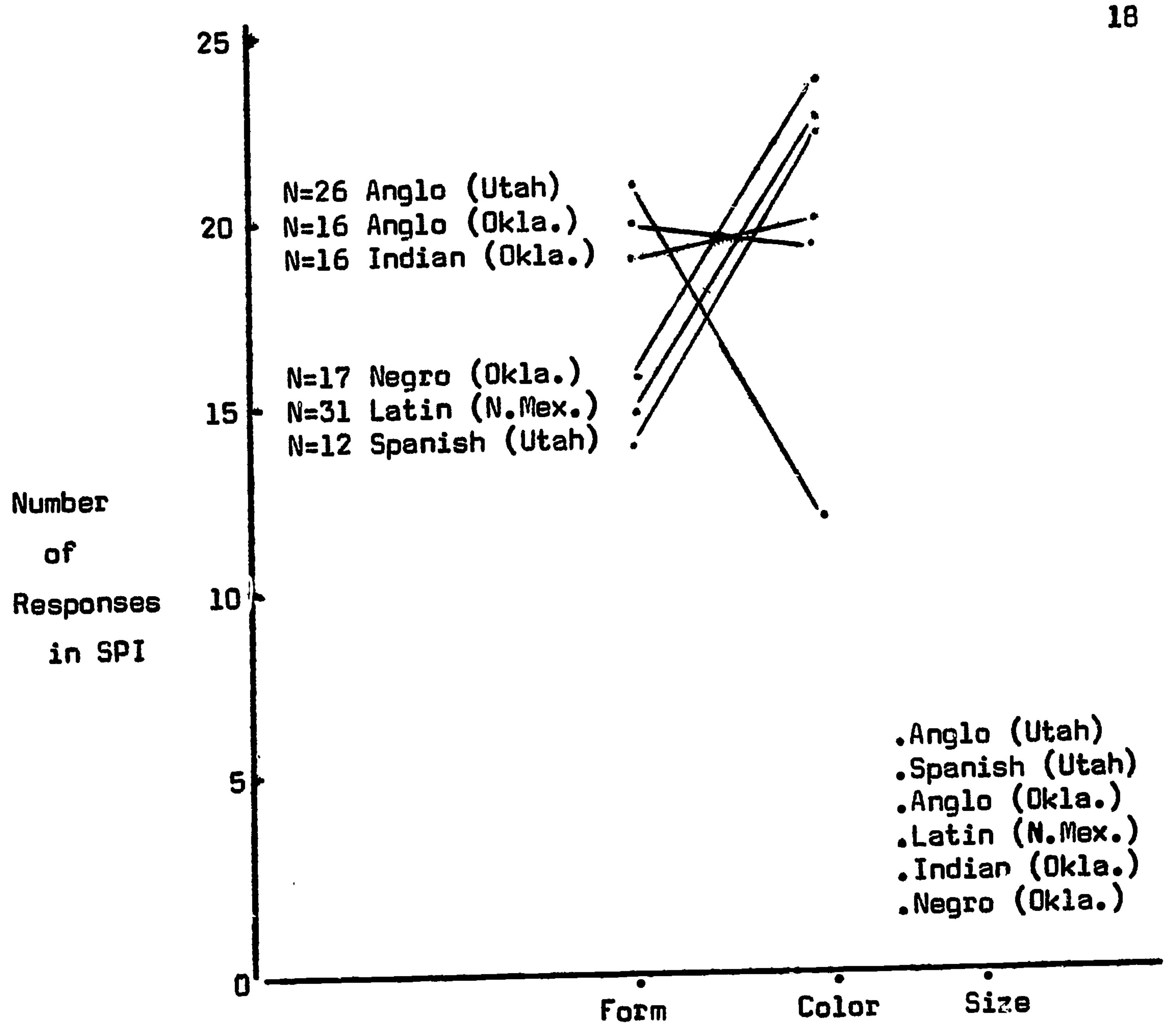
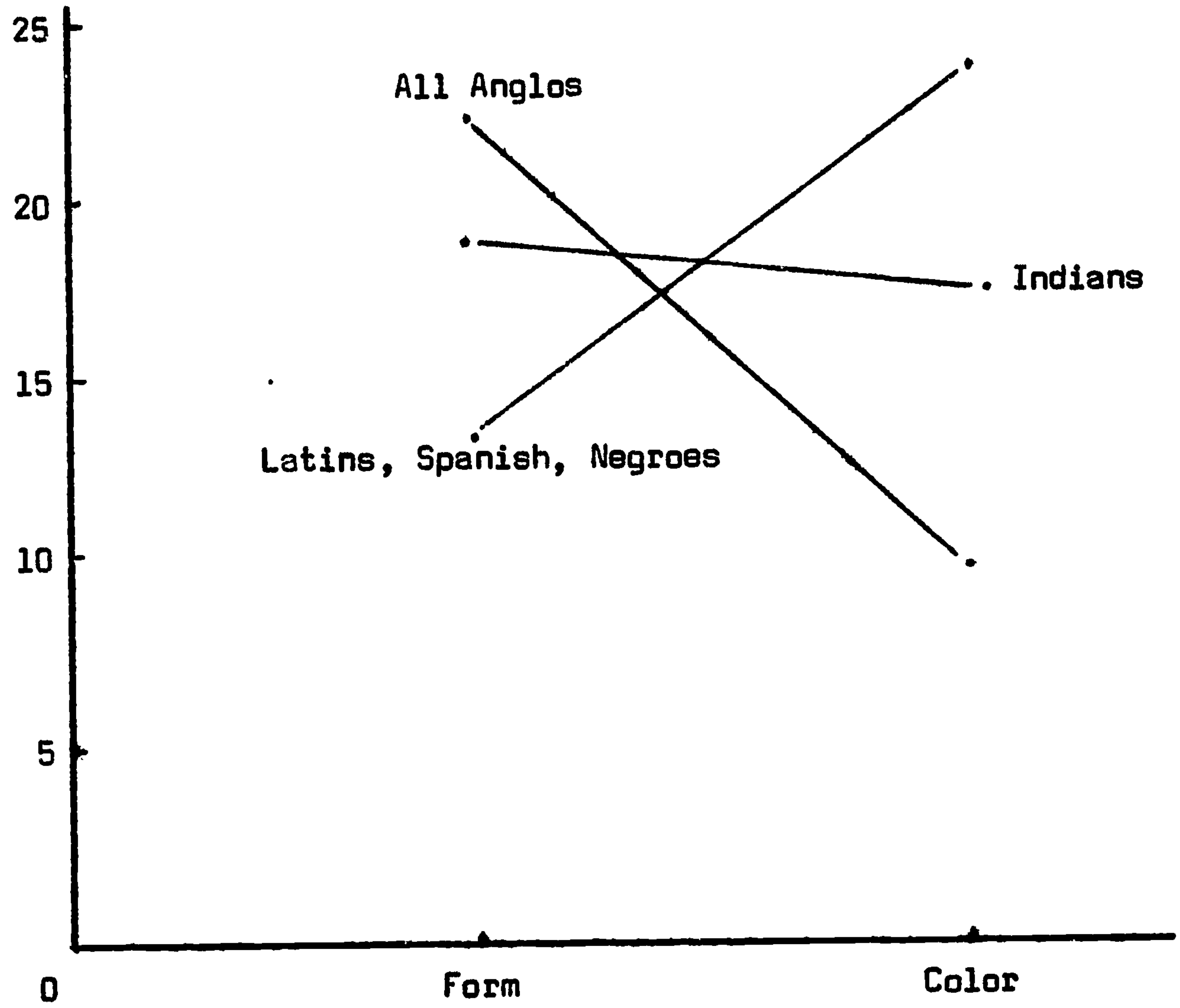

25
20
15
10
5
0
Number of Responses in SPI
N=26 Anglo (Utah)
N=16 Anglo (Okla.)
N=16 Indian (Okla.)
N=17 Negro (Okla.)
N=31 Latin (N.Mex.)
N=12 Spanish (Utah)
.Anglo (Utah)
.Spanish (Utah)
.Anglo (Okla.)
.Latin (N.Mex.)
.Indian (Okla.)
.Negro (Okla.)
Form
Color
Size

Figure 3



Average number of responses by total Anglos (Utah & Okla.), a composite of Latins, Spanish, and Negroes and Indians.

Figure 4

A review of many of the past studies of form and color preference revealed that nearly all of the populations sampled were white middle class Ss. An exception was Colby and Robertson (1942) who used both white and Negro children. They found that the Negro group showed a strong internal consistency towards higher color trend, regardless of mental and chronological age, as compared with the very strong form trend in an equivalent group of white children.

The statistically significant differences found between Ss of different cultural backgrounds in the Head Start samples indicated that the different stimulus preferences might be explained by a "perceptual style" better than by the older hypothesis of cognitive development. Important to this hypothesis were the mental ages of the Ss given in Table 2. Between groups there was no consistent relationship between high mental age and preference for form. For instance, the Indians from Arizona who preferred color as much as form had a higher average mental age than the Anglos from Utah who were very unidimensional with regard to form.

But since 83 per cent of the subjects were unidimensional in choice, an analysis of all Ss, without regard to culture, was made with respect to mental age. The following question was asked: across all Ss, with mental age held constant, are there still significant differences with respect to stimulus preference? The answer was a weak "no" (p. 1008). In the face of this evidence one might wish to revert back to the hypothesis of cognitive growth instead of true cultural differences. After all, if Ss who preferred form have a higher mental age than those who do not, one might feel compelled to dispel the idea of cultural differences.

Perhaps this discrepancy in the position put forth in favor of cultural differences can be resolved. Not proven, but explained. There are differences between cultural groups. Ss of a particular cultural group display a characteristic preference for a stimulus dimension that is statistically different from another group. This means, for instance, that within the Negro group more Ss prefer color, significantly more so than the majority of Anglos, who prefer form. But within that Negro group there are some Ss who are unidimensional in preferring form, going against the grain of their group. It seems that these Ss are also the ones who tend to have a somewhat higher mental age.

All the studies done in this country have shown one thing in common: As people learn to read, perform arithmetic problems, and other academic discriminations, they become form dominant. It is more rewarding to prefer form because most learning tasks require form discrimination. Therefore it may not be unreasonable to suppose that those Negroes who prefer form (and have a higher mental age) have already begun this shift to form because of a greater interest by their parents in teaching a few preschool skills, or because of other experiences in the home which tend to make form discrimination more meaningful. These mental age scores are obtained with the Stanford-Binet Intelligence Scale, and this instrument requires discriminations very similar to those in the classroom, namely in terms of form. Thus, the interpretation may be expressed; there are significant differences between cultural groups in terms of stimulus preferences. This means that members of different cultures come to school with different sets for stimulus discrimination. But within these groups there are some individuals who have a preference for form and a higher mental age than the rest of their group, and that is because they have already begun to experience what the others will experience within a year -- certain kinds of learnings which depend on form choice. That there are true cultural differences in stimulus preference is reinforced by Colby & Robertson's study where mental age made no difference.

Two other factors could be interpreted as substantiating the perceptual style hypothesis. One was the results of Suchman's (1966) study in Nigeria, Africa. She examined a large sample of African children, ages 3 to 15, and a preference for color was found in nearly all her Ss, even through adolescence. The other findings which would indicate the presence of a perceptual style was made by the author in Salt Lake City. The sample consisted of Anglos and children of Spanish descent, who came from similar economic backgrounds, had statistically similar mental ages, and had shared the same classrooms for several weeks. The results of the test showed their stimulus preference to be opposite of one another (see Figure 3).

The Shift From Color To Form

Children can handle concepts of both form and color at a very early age. The one they will prefer is considered by this writer to be determined by personality variables and socialization influences within a particular culture and/or race.

The characteristic shift from color to form found in most past studies is seen to be the result of the intervention of school, and not simply the product of maturation of cognitive ability. Lee (1965) has found that reinforcement for form discrimination in learning to read and other school activities is probably responsible not only for the shift in preference to form but also for differences in learning color and form concepts between preschool and school age children. Suchman and Trabasso (1966) find that color-oriented children have significantly more difficulty in solving form tasks than form-oriented children; the converse is also true. White (1964) states that an important factor in learning is whether the stimulus dimension selected is congruent with the child's perceptual preference. Suchman (1966) concludes that the reason for the Nigerian Ss <u>not</u> making a shift from color to form is due to the fact that these people do not experience education as it is taught in this country.

Thus, children who enter school preferring color will find it to their advantage to shift to form because of the nature of the school curriculum. The Anglo group, which has already shown a preference for form at the start of their formal education, shall show an increase in the average form score for their group. This will be due to a shift toward form preference of those individuals who were previously color dimensional.

<u>Hypothesis</u>

It seemed reasonable to hypothesize that the children who entered school for the first time in September would, by the end of the same school year in May, reveal a shift toward more form preference. This shift would be a result of the child's attempts to accommodate classroom learning experience. The Ss chosen to test this hypothesis were the three cultural groups at Anadarko. They had been tested in October, and eight months later, were retested. The results are found in Figure 5.

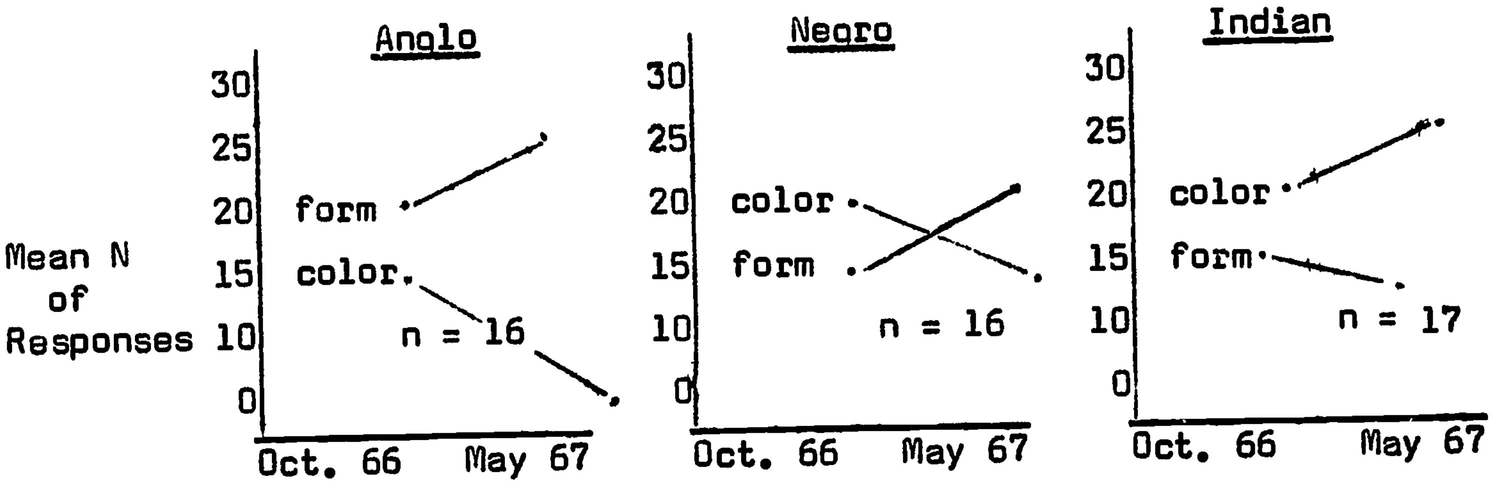


Figure 5

There were statistically significant shifts in the predicted directions for Anglos (.05) and Negroes (.01). The Indians, however, made a shift from essential neutrality to a preference for color, and although not significant (p = .15), was deviant enough from the hypothesis to warrant comment.

Discussion

Perhaps the Indian result can be expected upon the basis of prior cultural learning. One tentative explanation may be that these Ss, already withdrawn, become even more so during the school year and thus do not enter into the learning experiences. The differences in culture may be so great that these Ss are not fully integrated into classroom activities.

Another possible explanation may be found in thinking of color preference as indicative of an expressive personality. White (1964) suggests that a preference for color reflects a more impulsive type of response. Children at an early age are color-oriented and simultaneously express themselves freely. They are the ones who make the shift to form when circumstances dictate it, as in school. It may be that the Indian children were reared in a more restricted environment and were not allowed to express their feelings openly. (Persons who have worked closely with Indians report that this is emphatically true.) They thus become form-oriented at an early age. When in school for the first time, they are encouraged to express themselves freely as well as apply themselves to learning form discrimination. Unlike the other children, who have always been able to express themselves, the Indian children find that in the classroom it is intrinsically more important to express themselves (and be color-oriented) than it is to engage in the more serious classroom material (and be form-oriented). This hypothesis can be tested by acquiring measures of stimulus preference at an earlier age. If correct, then one will expect to find young preschool Indians preferring form while same-aged Anglos and Negroes are preferring color to a greater degree than form. It is also expected that the same Indian children will reveal a shift to form in their second year (first grade) of school.

Conclusion

The reported results indicate that stimulus preference cannot be explained satisfactorily simply by posting a fixed course of cognitive development. Rather it seems that a more logical conclusion is that stimulus preference indicates exactly that: a preference or perceptual style. From the consistency of the responses found within subcultures, it seems apparent that stimulus preference is a characteristic of personality, developed through specific patterns of socialization.

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A PERCEPTUAL COMPONENT OF VISUAL-ANALYTIC SKILLS

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Background

Kagan (1966) and his associates have studied a disposition labelled "reflection-impulsivity"; reflection defined in terms of the tendency of children to reflect over alternate solutions when coping with problems of high response uncertainty. High response uncertainty is said to be present in complex visual discrimination tasks in which a standard stimulus and a fixed set of response alternatives are present, and the standard-matching response is not obvious. Impulsive selection of a solution, as determined from low response latency, coupled with high error scores, has served to define the other end of the characteristic. Reflective behavior during reading readiness training has been shown in a longitudinal study to predict later success in acquiring reading skills (Kagan, 1965).

Problems of Operational Definition

Actually, the several operations by which high response uncertainty has been induced have varied considerably, even though they seem to be quite similar at one level of conceptual abstraction, as Kagan avers (1966, p. 498). The following operations demonstrate the range of operational definitions implicity in the various tasks: 1) high speed presentation of incongruous stimuli by tachistoscope (Tachistoscopic Recognition Task), 2) initial presentation of stimulus followed by delay before the comparator set is exhibited (Delay d Recall of Designs), 3) concealment of stimulus features which will permit matching, either through embedding or by selecting obscure features as identifiable differences (Matching Familiar Figures), and 4) requiring visual judgment of similarity of objects for which the stimulus has not been viewed but only palpated tactilely (Haptic Visual Matching). Thus, rapidity, delay, concealment or obscurity, and cross-sensory matching constitute some of the basic task operations of the Kagan studies. Although all of these opeaations may induce response uncertainty, they will certainly be affected by such subject capacities as 1) recognition threshold for rapid presentations, 2) visual memory, 3) visual analytic skills, add 4) inter-sensory coordination, respectively. The third of these capacities has received explicit and detailed attention in data interpretation (Kagan, 1966). Other skills such as comparator set scanning efficiency may well affect results also whenever tasks involve differing numbers of targets, as shown by Munsinger & Forsman (1966) in a cross-sectional study of age differences in visual search.

Whereas the correlations among error scores from the several tasks used to determine reflection-impulsivity tend generally to be significant, they are also modest (r = .30 to .60) -- enough to suggest that, in addition to this generalized response tendency, very different ability factors may underlie successful performance whenever the operations defining response uncertainty are shifted. In other words, very different information processing skills may operate and may interact differentially with the S's reflection-impulsivity. Thus, studies relying on one kind of task to elicit reflection-impulsivity may not permit generalization beyond that task until the exact relation of the task's operations to the dimension have been clarified.

<u>Tachistoscopic Presentation As An Example</u>

To examine one set of these operations in detail might further illuminate some of the issues already mentioned. In the tachistoscopic task, Kagan (1966) was careful to screen out of his sample those children who were grossly inadequate visually, i.e., those who could not recognize three simple designs presented at 175 milliseconds. In the actual task administration, however, Ss were presented incongruous objects at initial settings of 18 milliseconds. The original selection criteria thus did not rule out the possibility that some Ss could and others could not perceive the objects. That is, when all Ss were presented visual stimuli at identical shutter speeds, some may have been more error prone than others because they were less able to perceptually integrate what they had viewed at high speeds. Thus, one might judge in general that if individual differences in visual accommodation thresholds are ignored, Ss having perceptual integration difficulties will be placed under greater task-induced pressure to behave impulsively. This will be all the more true to the extent that the experimental situation is understood by the child as one requiring a performance from him.

Another consideration affecting differences in readiness to perceive an object presented tachistoscopically at high speeds is the development of the "relation of identity." Babska (1965), in studying this cognitive process on a visual matching task, has shown that by age four, 80.2 percent, and by age five, 93.3 percent, of her Ss had attained this relation. Her method of presentation allowed the child to view the stimulus for two seconds prior to the comparator set's introduction. But because of the long presentation time, no direct assurance is obtainable from her study that the relation of identity can be demonstrated by most five-year-old children when stimuli are available for inspection during only brief exposures. In fact, filmed eye-movement studies cited by Zaporazhets (1965) show clear progress in children's visual inspection patterns for single objects after the fifth year. Eye movements of six to seven year old children more adequately reproduced the outline of a figure than did those of younger age groups. This was accomplished by their engaging in a greater number of eye movements for shorter fixation periods, a finding consistent with the results of Munsinger & Forsman (1966). Greater search efficiency may well be built up perceptually in an incremental fashion that is analogous to instrumental habit growth (Harcum 1967), so that many preschool and primary children may as yet be unable to perceive even familiar objects at the fastest of Kagan's tachistoscopic settings.

Overall exposure time was quite long, i.e., 20 seconds, in the studies mentioned by Zaporozhets above, again making it difficult to conclude what proportion of children of particular ages might be able to perceive objects presented at fast speeds. Hence, on various grounds it appears to be risky to assume that all preschool children and children in the earliest years of school will be able to perceive visual stimuli presented at standard tachistoscopic settings. That Kagan has become aware of various possibly contaminating influences in his studies is clear from his discussion of alternate interpretations which should be investigated (Kagan, 1966, p. 503), but the earlier phases of work with reflection-impulsivity were relatively uninformed by these more recent observations.

In the tachistoscopic task used in some of the Kagan studies, the problems of direct interpretation of reflection-impulsivity now become evident: latency and error scores may be confounded with individual differences in children's visual integration efficiency, their developmental level for the relation of identity, and the progress of their visual search skills, among other variables.

Pre-establishing a Recognition Threshold

A precautionary step which would remove some of these questions would be to first establish whether the child could perceive simple and familiar objects at the fastest tachistoscopic settings to be used, and only thereafter to treat his errors and response times as pure indicators of reflection-impulsivity. Initial tachistoscopic testing would allow one to determine a threshold at which each child was still able to perceive a given object set. In this respect, the tachistoscopic task has decided advantages over the other operations that have been used to induce response uncertainty, i.e., one can equate Ss experimentally for recognition thresholds but cannot so readily equate them for visual memory, visual analytic skills, inter-sensory coordination, and such. In these latter instances, statistical rather than experimental control would have to be elected.

Multiple Levels of Analysis Further Confounds

Another experimental problem is introduced by the fact that reflection-impulsivity can appear at multiple levels of cognitive problem solving (Dyer, 1966), i.e., at any level where evaluation of some preceding level occurs. For example, after a perceptual act af decoding, as when a semantic or symbolic unit that is known is matched to another, an evaluation can occur. This testing of the decoding response's adequacy could be either impulsive or reflective. Alternatively, in the case of a problem which requires for its solution the generation of hypotheses, evaluation can again follow, and so on. Dyer's conception of reflection-impulsivity thus places it within an information processing framework. If one adopts this viewpoint, it appears that the least complicated level at which reflection-impulsivity might be studied would be in a simple decoding task, i.e., a task involving perception only, unaccompanied by hypothesis generation or other higher level cognitive processes. From this a second desideratum for designing a study may be extracted: the task should require Ss to behave only at the perceptual level.

Modifiable Behavior a Second Requirement

For futher experimental control, one would hope to evoke by the tachistoscopically-presented, uncertainty-generating task, a class of perceptual behavior susceptible to modification in the direction of developmental advancement, so that Ss would, during the study, reduce their errors as a result of some appropriate treatment. This would represent an extension of the earlier Kagan studies, which have been correlational in character. Now that the generality of reflection-impulsivity and its predictive validity have been demonstrated, an extension in this direction would permit more detailed analysis of the dimension's relation to perceptual skills.

Psycho-Social Importance of Visual Perceptual Readiness

The analysis of visual perception, as outlined above, is further appealing from the viewpoint of social problem solution. Repeatedly problems of educational failure have been traced to poor reading development. One essential component of reading readiness is visual perceptual skill for detecting the relation of identity when the only relevant discriminal property of the stimulus is form, i.e., alphabetic and numeric character detection must be carried out without the aid of color, size, or other dimensional characteristics. Because visual perceptual readiness is, thus, crucial to reading development, one might wonder to what extent the reading difficulties of psycho-socially disadvantaged children are related to poorly developed visual recognition skills. The present study was planned to examine the "relation of identity" during tachistoscopic presentation to Head Start children of visual stimuli, which could be discriminated only on the basis of shape and spatial orientation.

Procedures

Conceptual Moorings

In this study's original proposal, titled "Reflection-Impulsivity and Reading Readiness," attention was drawn to a perceptual component of the cognitive style labelled by Kagan and his associates reflection-impulsivity. Prior studies have drawn attention to a larger component of cognitive behavior in this connection--specifically to the child's use of hypothesis-like strategies in the resolution of stimulus ambiguity. That we have been dealing with a more limited aspect of such strategies, i.e., the perceptual recognition of an object viewed for only a brief duration, has tended to be obscured by our attempts to connect this with Kagan's procedures. It may, thus, be useful at this point to emphasize again that, in terms of our experimental procedures and conceptualization of the problem, we have sought only to deal with the accuracy of the child's perceptions rather than to tackle the more global dimension out of which the study's impetus grew. It seems reasonable, nevertheless, to believe that results obtained from this perceptual study will be applicable to the prediction of later reading success. Since this is essentially an empirical question, it can be resolved by follow-up studies in the first and second grades, using the present sample.

Instruments

Since the last quarterly report, a criterion instrument of form perception accuracy, the Visual-Analytic Skills Test (VAST), has been developed and field tested as a part of the study. Copies of the VAST plus samples of the India ink drawings of in-class objects used in the study have been forwarded to the Bureau of the Budget together with requests for approval for future use.

Subjects

Arrangements were made with three teachers of Austin Head Start classes in two different schools to use selected children from their classes as subjects in this study. Ten children in each of these classes had been selected previously as part of the Austin Head Start Center's evaluation sample. These 30 children comprised the basic sample of this investigation. Children were further cleared to make sure that none of them had had visual defects detected during the medical Head Start workup.

Pre-Testing

Each child was first presented, in the window of an individual reading tachistoscope at 1/10 second exposure time, India-ink form drawings of objects that were then on display in his classroom. These had been assembled for convenience in a corner of the classroom where testing was to be conducted. If the child recognized the object presented, he was to indicate this by pointing to its referent. Some children showed difficulty in following this instruction about pointing and would instead verbalize a response each time. Either response was scored as a plus if the child had made a correct identification. Incorrect guesses were scored as minus, and non-guesses were scored as zero. Zeroes were to be treated differently in subsequent procedures and analysis.

If the child was unsuccessful at the 1/10-second setting, he was tried at 1-second; if successful he was advanced to 1/25-, 1/50-, and 1/100-second, or until he failed. A child was considered successful at our setting if he could identify as many as one-half of the first 10 form drawings presented. Because non-guesses were not counted as errors, additional presentations beyond 10 were allowed, until a scorable series was completed. Further, if a child's performance showed marked improvement toward the end of a series, he was continued for six additional trials to determine whether, once he had overcome initial disorientation, he might yet be successful at the present setting. A success rate of one-half was criterial in any event.

As soon as the settings at which a child succeeded and failed had been determined, he was immediately administered the <u>VAST</u>.

The first 32 items of the VAST were presented at the child's last successful setting, and the remaining 28 items at his last unsuccessful setting. Nineteen children succeeded by our criterion at all settings, including 1/100-second, but the VAST provided sufficient ceiling for further differentiating among these children who met criterion at all settings.

The pool of children was now rank ordered on the basis of error scores, i.e., total (minuses only) on the VAST and a median division was accomplished into high and low error groups. One-half of the children from each group was assigned randomly to experimental and control conditions. One child was lost to the study at this point out of the Control High Error Group, leaving the following compositions and numbers in groups. Control High Error (CHi), 6; Control Low Error (CLo), 8; Experimental High Error (EHi), 7; and Experimental Low Error (ELo), 8.

Treatments

Each experimental subject received six spaced, ten-minute instructional sessions in which he viewed in-class objects at the first setting at which he had failed on pre-test, or at 1/100-second for children who had succeeded at all settings. Objects were presented in a randomized order. The child had opportunity to flick a toggle switch on the reading tachistoscope for as many presentations as he wished before making a guess about what he had seen. Insomuch as feasible, children were required to point to the object presented, even when this required them to expend additional effort to do so. Instructions emphasized that viewing to gain information was "free" while making guesses required effort. Children were thus encouraged to maximize their information gain while minimizing non-productive effort. That is, correct identifications would be reinforced by confirmation (the light in the viewer remaining on continuously), whereas incorrect identifications would simply lead to additional effort. A blank screen served as feedback indicating that the child should resume presentations of the same object until he could identify it. It should be noted that instructions were not calculated to stop guessing, per se, but to inhibit uncertain guesses when more information was freely available for the child to discover.

Final instructional sessions were given on May 23, with post-testing being started on May 24. As of the present, it is anticipated that all post-testing will be completed by May 29, after which data analyses will commence. At present, all results of pre-testing have been keypunched and scored, and experimental and control groups have been collated with the main evaluation sample to obtain results for them as members of the evaluation sample. This will permit direct comparisons between these data and those from the Stanford-Binet, Preschool Inventory, and Behavior Inventory.

Results

Experimental (8 boys; 7 girls) and control (8 boys; 7 girls) Ss had been assigned randomly to their groups. Since, however, the total number of Ss was small, analyses were performed for the two groups using pre-test measures to determine whether they were different in initial standing. They were not different on the five scales of Preschool Inventory, age, raw score items of the Behavior Inventory, Stanford-Binet IQ and MA, and the Visual Analytic Skills Test (VAST) error scores, rate of completion, and tachistoscopic fail-out setting. Initial standings on the three scores obtained in the VAST's administration were particularly important, since it was these which had been expected to undergo changes as a result of the experimental treatment.

After pre-testing, two of the control group Ss were lost, so all additional analyses were performed using the remaining Ss. The time elapsed from pre- to post-testing ranged from eight to ten weeks. All experimental Ss had received six 10-minute instructional sessions during this period, and all had attended Head Start programs.

The first major analysis was of change scores for the two groups. It had been hypothesized that the experimental group would demonstrate a greater drop in errors during the training period. Both groups showed declines in error scores over the period. (Control, $M = 6.3077$; Experimental, $M = 4.4000$), but the null hypothesis for differences between the groups could not be rejected (Table 1).

TABLE 1

CHANGE SCORES FOR EXPERIMENTAL VS. CONTROL Ss

Source	Mean Square	D. F.	F. Ratio	P
Total	23.3968	27		
Groups	25.3451	1	1.087	N.S.
Error (G)	23.3219	26		

The tachistoscopic familiarization instruction, using form drawings of familiar in-class objects, made no apparent differential impact upon the experimental Ss. In fact, so far as the raw means were concerned, a slight edge was shown for the control group. This was probably so because the two Ss lost from the control group both initially had high error scores, and it was found that Ss with high initial error scores made smaller gains on the average. Their losses would thus have tended to improve the apparent error elimination rate for the control group.

The relation of VAST error scores to response pacing was also studied. Each child had been assigned a number from 7 (almost always answers immediately, and never hesitates) through 1 (almost always hesitates and reflects before making a decision) on pre-test based on the examiner's observations of his rate of responding. This was used as a substitute for a direct measure of response latency. The examiner was unaware at the time of pre-test of the hypothesized reaction between latency and errors. Correlations between these variables were -.4241 and -.3494 for T_1 and T_2, respectively. The correlation at T_1 was significant. Response hesitation (reflection?) was associated with higher error scores among these Head Start children -- a finding just opposite that previously obtained by Kagan (1966, p. 498).

Pre- and post-analysis of VAST error scores showed them to be normally distributed, so an additional analysis was performed using a trials by groups arrangement. Two of the experimental Ss were dropped randomly, leaving 13 Ss in each group. Again the groups' main effect was non-significant as reported above. The group-by-trials interaction was also non-significant. The trials main effect, however, showed that the groups made significant gains, i.e., reduced their error scores during their Head Start experience (Table 2).

TABLE 2

GROUPS-BY-TRIALS ANALYSIS OF VARIANCE OF VAST ERROR SCORES

Source	Mean Square	D.F.	F. Ratio	P
Total	72.3002	51		
Between	119.2123	25		
Groups	177.2308	1	1.517	N.S.
Error (G)	116.7949	24		
Within	27.1923	26		
Trials	421.2308	1	37.063	<.05
G By T	13.0000	1	1.144	N.S.

VAST errors dropped for the control group from 20.3846 to 13.6923 from T_1 to T_2. Similarly the experimental group's errors declined from 23.0769 to 18.3846.

Despite these highly significant reductions of error scores, a stability coefficient of .8397 was obtained for VAST error scores from T_1 to T_2. Thus, even though the groups showed rapid change, individuals tended to maintain their relative positions within the overall group throughout the process.

Discussion

The experimental treatment used with these Head Start children was clearly ineffective in producing visual discrimination accuracy gains over an 8-10 week period. While it is not possible to say exactly why this was so, one hypothesis worth consideration may be offered. Behavior modification procedures require first that Ss have available the component responses which potentially can combine to yield the end behavior desired. In the absence of the component units, little success can be expected from a training program. It may well be that this is the problem with the treatment used here, i.e., if these children have not yet acquired the symbolic units involved, then the effort to increase accuracy would be equivalent to waiting for an S to emit a behavior which is not yet in his repertoire. If this is the case, then some play-discovery treatment, which would permit children to acquire the necessary units, might be expected to yield more remarkable results. The clearly negative findings leave few other avenues open.

Beyond this, it is interesting to note the overall gains registered for both groups during this time. One may wonder whether these gains were an indirect result of Head Start experience. Since comparable data are not available on a non-Head Start control group, alternate interpretations cannot easily be eliminated, e.g., that spontaneous perceptual growth is occurring during this time. The relatively high stability coefficient might, in fact, favor a developmental interpretation of the VAST error reduction. In this connection, it should be noted that VAST pre- and post-test errors were consistently negatively correlated with MA and IQ on the *Stanford-Binet* ($r = -.4748$ to $-.6313$) and with the Developmental Scale of the *Preschool Inventory* ($r = -.5705$ and $-.6859$).

The failure to replicate the Kagan finding regarding the relation of impulsivity to error scores may be due to sample characteristics. Kagan (1966) noted in a previous discussion that in his analyses he had not differentiated those children in the highly reflective group who might hesitate because of inadequacy and fear of failure. It may be that Head Start programs contain an overrepresentation of children who are hesitant for just this reason. In fact, this is what one might expect from a knowledge of their characteristics. Further, this relation might have been even more highly negative if all Ss had been required to complete the *VAST* at identical tachistoscope settings, as in the Kagan studies, since this would have forced the hesitant Ss to engage in guessing at settings more rapid than those at which they successfully identified 50 percent of the familiar objects on the trials immediately preceding the *VAST* pre-test. Use of a hesitating estimation might also have influenced results.

Conclusions

It would seem unprofitable to pursue further the kind of treatment used in this study with Head Start children. Future studies might concentrate on providing geometric-object manipulation experience as more promising for the initial learning of perceptual units.

Fairly consistent, significant, and moderate relations were obtained between VAST error scores and other indicators of development. Moreover, the VAST seemed relatively sensitive for detecting changes occurring in Head Start children during their initial training experience. For these reasons, additional studies of the VAST as a possibly useful indicator of development in preschool children would seem to be justified. Simultaneous administration to a non-Head Start control group would permit a decision about whether Head Start experience is in some way responsible for the observed gains.

The importance of controlling for the recognition thresholds of individual children before administering a standard visual task has been borne out in this study. Such procedures would allow more adequate pre-screening of Ss so that a standard task could be administered to all Ss at tachistoscopic settings equated for Ss' actual recognition ability. In this way, reflection-impulsivity could be studied in a more definitive manner, with the assurance that certain kinds of error variance would be systematically eliminated.

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