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Because of the increasing use of color in instructional materials at the level of the primary grades, the Health Service Department of the Denver Public Schools became interested in investigating the color vision of 5- and 6-year-olds. A project was established to create color-vision testing methods and to use those methods to ascertain incidence and to identify color-deficient pupils. The two basic types of tests used were (1) color matching and (2) recognition of colored symbols differentiated from surroundings of other colors. Some 3,400 children were tested during the 1967-68 school year. It was found that the tests used were practical for their age group. The tests produced high interest and should be used either in the latter part of kindergarten or in the first grade. The incidence of some degree of color deficiency was 0.5 percent for girls and 3.0 to 3.5 percent for boys. The color-symbol tests were significantly more definite than the color-matching test. (WD)

AN EVALUATIVE STUDY OF COLOR-VISION TESTS FOR KINDERGARTEN AND FIRST GRADE PUPILS

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The part that color-vision plays in the life of every individual has been recognized and studied since John Dalton described his own color deficiency in 1807. In addition to the esthetic aspects involved, there are practical applications in every day living. Color-vision testing has been undertaken by a wide variety of groups for divergent purposes. Implications for industry, the military, commercial transportation (airlines, railroads, and buses), and traffic are obvious and important. Many tests have been developed and are in common usage. Most adults have experienced one or another of the color-vision tests in connection with driver licensing, pre-employment health evaluations, and the like. Schools too have been aware of the significance of this aspect of vision. Testing has been done in the secondary school in connection with vocational counselling. Based upon this rather wide experience, incidence of color deficiency has been reasonably well established (males 3+%, females 0.5%). Understanding of the basic physiology of color-vision has increased since the early work of Young and Helmholtz more than 150 years ago. At the present time then, there is a reasonable body of knowledge concerning color-vision, methods of testing, and theory related to its mechanisim.

The relationship between color-vision and learning has received little attention until the last ten years. Classically, little use of color has been made in instruction. With the advent of increased interest in the learning process, and particularly in dysfunctions of the processes, this situation has undergone considerable change. Today color is being more and more widely used in instruction, especially in the primary grades. A great many examples could be given -

Slides #1 and #2

The Cuisenaire Rods, Words in Color, and The Sullivan Programmed Primer are but a selected few. With this increase in the use of color it is logical to question the characteristics of color perception among the users of these new materials, that is, among the young school-age children. Upon investigation it appears that little has been done with the five and six year old group in regard to color-vision. Many questions remain unanswered. Are the tests used for older individuals suitable for five year olds? What is the incidence of color deficiency in this age group? Does color-vision make any difference in school? If it does, can the color deficient child be helped?

The Health Service Department of the Denver Public Schools became interested in these questions and has undertaken a study to seek answers. Assistance was sought from the Denver Ophthalmological Society and the Department of Ophthalmology of the University of Colorado School of Medicine. An advisory group of individuals from these agencies met with school personnel to consider details of a study the goals of which would be answers to questions pertaining to color-vision and its' role in learning in the early school years. With this reasoning a study was developed. Essentially it contained two parts. The first part, which is being reported here, consisted of establishing practical testing methods and the use of those methods to ascertain incidence and to identify color deficient pupils. This was done during the 1967-68 school year. The second part consists of correlating known color deficiency with the learning process. Such is still progressing and will not be reported at this time.

Review of the literature, and discussion with the advisory group indicated at least two basic approaches to color-vision testing. One employs color matching in one or another form. The other employs recognition of symbols of the test color differentiated from surroundings of other colors. The familiar yarn test is an example of the first, and the Ishihara Test of the second. Adaptations of both methods that were age suitable were included in this project.

Slide #3

For the color matching part of the testing, a set of test materials was prepared. The set consisted of two muffin tins, the cups of which were painted with test colors, ie, black, white, yellow, blue, red, and green. Identically painted was a set of ping-pong balls. The test was presented to the child being evaluated, with the ping-pong balls in one of the tins with directions to put the balls in the cups of the other tin, matching the color of the ball with the color of the cup. These directions seemed to be readily understood by the five and six year old children who were being tested, and the manipulation necessary also seemed to be within their motoric ability. There was high interest in the test on the part of the children. The test was useful in establishing rapport, and in orienting the subject to the general area of the test.

Slide #4
Slide #5

The symbol recognition part of the evaluation utilized standard Ishihara pseudo-isochromatic color plates, and also the newer American Optical Company's HRR plates. These are illustrated in the accompanying slides. They depend upon the subjects ability to differentiate a symbol in one color from a background of another color.

Because of the ages of the subjects, responses were in terms of finger tracing symbols upon the protected surface of the plate rather than a verbal response as is commonly used with older subjects. Only selected representative plates were used rather than the entire series in both the Ishihara and HRR evaluations. Initially a similar test utilizing a visual testing machine, the Titmus Vision Screener with the color-vision slide was included. Experience with children in the 5 - 6 year age group indicated that this procedure was more time consuming and conceivably introduced other factors (spacial, motoric, and verbal) such that it was empirically discontinued after a trial with several hundred children. An additional dimension was incorporated into the study by questioning the classroom teacher as to her opinion of the adequacy of color-vision of each subject. This was done without knowledge on the part of the teacher as to results of the tests administered.

With the tests described, two individuals (both nurses), tested over 3400 five and six year old children during the second semester of the 1967-68 school year. This experience led to several conclusions:

- tests of this nature are practical for use with kindergarten and first grade children
- the time necessary to administer the tests is approximately two minutes per child once the tests are optimally structured, and the examiners experienced
- optimal timing is in the middle or later part of the kindergarten year, or any time in the first grade year
- teacher-pupil interest is high and could be utilized in correlation with associated learning.

In addition to these conclusions of a general nature, this study was analyzed for conclusions from the raw data. Additional conclusions were as follows:

- the incidence of some degree of color deficiency was in the order of 0.5% for girls and 3.0 to 3.5% for boys
- the color matching test was significantly less definitive than the color symbol tests
- teacher judgment should not be used in lieu of the more sensitive tests.

In general it was the feeling of all those involved in the project that the testing of color-vision can be undertaken with children of initial school entrance age with expectation of valid test results at a reasonable investment of time. Further studies are needed to determine correlations and practical implications in the total learning process of elementary school children.

Appreciation of the varied efforts of the advisory group, the testors, the school administrators, and of the pupils and teachers who took part, is extended.

Details of the initial planning, technical aspects of the tests used, and specifics of the analysis of the study, were not included as being inappropriate to this presentation, but are available to interested parties upon request. We would encourage other school districts to undertake similar studies and would appreciate hearing of their results.

Thank you.

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