1040-5488/99/7609-0631/0 VOL. 76, NO. 9, PP. 631–636
OPTOMETRY AND VISION SCIENCE

ORIGINAL ARTICLE

Evaluation of a New Color Vision Test: "Color Vision Testing Made Easy®"

SUSAN A. COTTER, OD, FAAO, DAVID Y. LEE, OD, PhD, FAAO, and ALAN L. FRENCH, OD

Southern California College of Optometry, Fullerton, California (SAC), Illinois College of Optometry, Chicago, Illinois (DYL), and Private practice, South Charleston, West Virginia (ALF)

ABSTRACT: *Purpose.* A new pseudoisochromatic color plate test, "Color Vision Testing Made Easy®" (CVTMET) has recently been introduced. Said to be designed for all age groups, including pre-school children, it uses the identification of simple shapes and objects to detect red–green color deficiencies. We evaluated the CVTMET to determine if the test is suitable for color vision screening of young children. *Methods.* Forty-one adults predetermined to be color normal (n = 20) or to have hereditary red–green color deficiency (n = 21), served as subjects. A battery of color vision tests including the Ishihara, Panel D-15, and the anomaloscope were used for diagnosis and color deficiency classification. Subjects were then tested with Part I and Part II of the CVTMET test and results were compared to the Ishihara, Panel D-15, and anomaloscope. In addition, the CVTMET was used to screen for color vision deficiency in 152 kindergarten children 5 to 7 years of age. *Results.* The pass/fail results for the adult subjects were the same for Parts I and II and compared favorably with the anomaloscope. There were no false positives (100% specificity) and only a few (2 of 21) false negatives (90.5% sensitivity). The two color-deficient subjects who passed the CVTMET had the mildest color deficiencies (simple deuteranomaly) and also passed the Ishihara test. Testability of kindergarten children was found to be 100%. Color vision deficiency occurred in 5.06% of the boys, which is about the same frequency found in older boys of similar ethnic background. *Conclusion.* This preliminary study indicates that the CVTMET appears to be an excellent screening instrument for red–green color deficiency in adults and has been shown to be useful for examining color vision in children 5 to 7 years of age. (Optom Vis Sci 1999;76:631–636)

Key Words: pseudoisochromatic plates, color vision deficiency, children's color vision, pre-school screening, Color Vision Testing Made Easy® test

There is a recognized need for a color vision screening test for young children.[1–4] The identification of congenital color deficiency is important because color is used in pre-school, kindergarten, and early elementary grades to provide a stimulating environment and more importantly, as a teaching tool. Color is often used as a vehicle to teach concepts such as same and different, group identification, patterning, and classification. A teacher might not realize that it is the color recognition component of the educational task or material that is confusing to the child with an undiagnosed color deficiency, not the educational task itself. Thus, the child might appear to be slow or thought to have learning difficulties. If it were known that the child had a color deficiency, teachers could easily adapt their instructional methods to be less dependent on color discrimination. Consequently, a color vision screening test that could be administered to young children in the eye care practitioner's office or at school vision screenings would be quite useful.

Despite the value of having a color vision screening test appropriate for testing young children, attempts to develop such an instrument have been difficult. Most clinicians and researchers recognize that pseudoisochromatic (PIC) plate tests such as the Ishihara and Dvorine, although very effective in screening for red–green color deficiency in adults, have limited effectiveness for young children, primarily because the cognitive demands are beyond the capability of the young child.[5] In an attempt to overcome the cognitive-related difficulty young children encounter with traditional PIC tests, researchers have attempted to develop different instruments and strategies specific for young children.

PIC tests developed or used for young children include the AO-HRR, Ishihara Test for Unlettered Persons, Guy's Color Vision Test for Children, Kojima-Matsubara Color Vision Test Plates, the Velhagen Pflügertrident, the Pease-Allen Color test, and the APT-5 Color Vision Screener. The AO-HRR, the Ishihara Test for Unlettered Persons, and Pease-Allen tests use symbols (e.g., square, circle) that can be recognized by a young child. In addition, the Ishihara Test for Unlettered Persons also contains

plates with "simplified pathways" that can be traced. The Kojima-Matsubara test conrains pictures of familiar objects including animals. The Velhagen Pflügertrident tests uses the letter "E" in various orientations with a template to be matched with the target and the Guys uses templates to match letters against. Most of these tests are designed to or can be adapted to use either a matching or forced-choice format. However, at present, there is no color vision screening instrument for young children that has found widespread acceptability.[6,7]

Birch and Platts[8] reported that young children had difficulty performing the Velhagen Pflügertrident test and found it to be unreliable for color vision screening in that it failed to identify 7 of 18 color deficient children. In the same study, the authors found the Ishihara Test for Unlettered Persons to be suitable for 4- to 7-year-old children provided repetitions are permitted as 20% of 3 to 4 year olds required a second administration to complete the test satisfactorily.[8]

Hill et al.,[9] in comparing the test results from the AO-HRR, the Ishihara wavy line, and the Guys tests to those from the anomaloscope found a very high and unacceptable proportion of false positives for their 439 male subjects aged 3 to 11 years. Although it was out of print for many years, the AO-HRR is still used by many practitioners, who often modify the administration procedures (e.g., allowing tracing of the shapes) when testing young children, despite Hill's conclusion that these tests were not suitable for screening children under the age of 8 years[10] and the report by Verriest et al.[11] that 50% of the 3 to 5 year olds in their study were erroneously classified as having a color deficiency.

Lee et al.[12] found that color normal children aged 4 to 7 years could not consistently recognize the pictures of the Kojima-Matsubara Color Vision Test Plates. In addition, they reported that color deficient adults did not follow the expected response patterns given in the manual, thus questioning the validity of the test. Although the Peace-Allen test appeared to be a very promising color vision screening test for young children,[13] it is not commercially available.

A common problem for all PIC tests is that a standard illuminant such as a Macbeth Easel light must be used in a dark room, which may pose a logistic problem in typical vision screening settings. The self-illuminated color test, the APT-5 Color Vision Tester, eliminates the need for a separate standard illuminant and has been used in children. Swanson and Everett[14] reported that although it did not work well for their 3- and 4-year-old subjects, the APT-5 was a suitable color vision screener for children aged 5 years and older. The APT-5 test is, however, significantly more expensive than any of the PIC tests.

Despite recent efforts to develop color vision tests specifically for young children, screening for color deficiency remains somewhat of a clinical dilemma,[5] and at present, there is no color vision test specifically designed for children that has found widespread acceptability.[6,7] An instrument with good validity that would allow for the rapid assessment of color vision in young children of preschool and kindergarten age is desirable.

The "Color Vision Testing Made Easy® test" (CVTMET, Franel Optical Supply Company, Maitland, FL) is a commercially available PIC color vision test designed specifically for young children. It requires the patient to identify geometric shapes (circle, square, star) or familiar objects (boat, balloon, dog) in a typical vanishing plate format (Fig. 1). Thus it is not necessary to identify or trace numbers (as in the Ishihara test) which can be difficult for young children. Because each of the two parts has a demonstration card containing the test figures, a matching format can also be used.

Part I contains 9 plates. All plates contain two shapes except for plate 8, which has three shapes. Plates 1 to 6 are designed such that one of the two shapes vanishes for red–green deficient observers. The other shape can be readily seen by both color normal and color deficient observers. All shapes on plates 7 to 9 are the vanishing type, so the expected response is for the color normal observer to see all shapes and the color deficient observer to see no shapes. Part II is composed of 3 plates (A, B, and C), each consisting of a single vanishing-type object (boat, balloon, and dog).

Plates 1, 5, 6, 8 (Part 1), and A and C (Part 2) have background discs of various shades (level, kind, and type) of green and blue-green. The vanishing shapes or objects are made of three shades of brown. The shapes that are visible to both color normal and color deficient observers are made of saturated yellow discs. Plates 2 and 4 use various shades of brown for background, green for the vanishing shapes, and blue for the figures visible to all observers. Plates 3, 7, 9, and B use various brown, yellow, and orange discs as background, several shades of green for the vanishing shapes, and a very saturated cyan for the figures visible to all observers. The colored discs are of various sizes on all the plates.

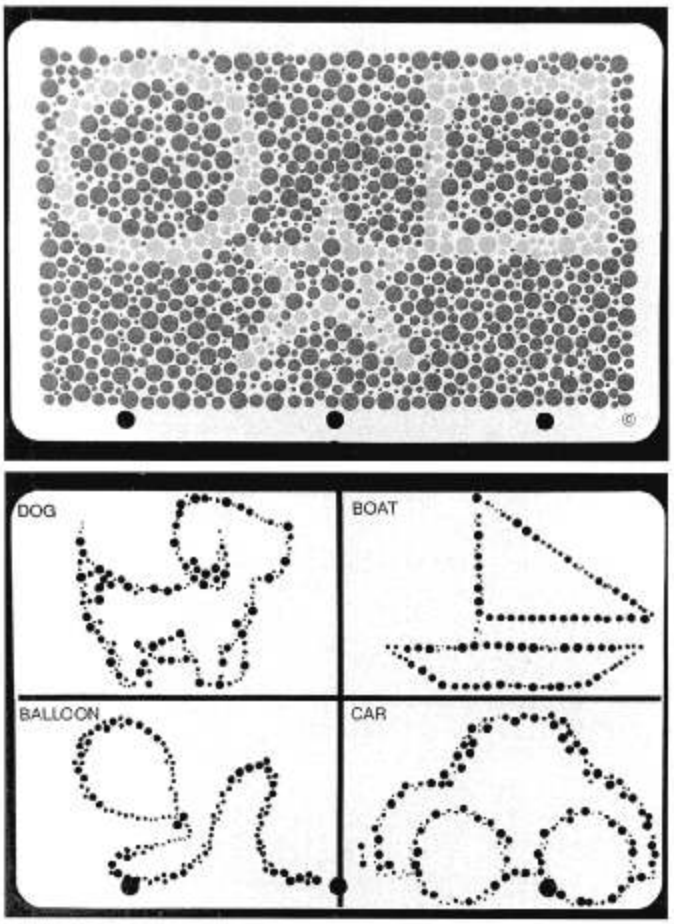

FIGURE 1.
Color Vision Testing Made Easy® demonstration cards. A: Part I; B: Part II.

When we first discovered the CVTMET, we felt it had several design features that made it appear to be a promising colot vision screening test for young children. These included the following: the use of shapes and figures familiar to young children, thereby eliminating the need for a verbal response; adaptability to a tracing, matching, or forced-choice format; easy administration; and inexpensive cost.

A review of the literature, however, did not reveal any data to substantiate the validity or usefulness of the CVTMET. Because of our interest in finding a suitable test for screening young children for color deficiency, we investigated the CVTMET's validity. This was done by evaluating predetermined color normal and color deficient adults and comparing their test results from the CVTMET to those from the anomaloscope (the validation criterion) and the Ishihara and Panel D-15 tests. We also evaluated the CVTMET's usefulness in screening for red–green color deficiencies in kindergarten children aged 5 to 7 years.

METHODS

The CVTMET is comprised of two parts. Part I is for the "general public" and Part II is for "the very young or those with learning disabilities." According to the test instructions, each part can be used as a stand alone color vision test. Part I has 10 separate color plates. The first is a demonstration plate (Fig. 1A) that shows the three test shapes - circle, star, and square. The demonstration card is not used for scoring. Test plates 1 to 9 have either two or three of the aforementioned shapes. According to the instructions that accompany the CVTMET, individuals with normal color vision should be able to identify all the shapes on all the test cards (Table 1). The expected responses for color defective individuals is that either one or all the shapes on a test plate are not seen. Part II consists of a demonstration card which contains black and white schematics of a dog, boat, balloon, and car (Fig. 1B) and three color test plates (A - boat, B - balloon, and C - dog).

Adult subjects

Twenty color normal and 21 red–green color deficient subjects (6 protanopes, 1 deuteranope, 2 protanomals, and 12 deuteranomals) participated in the study. Their ages ranged from 22 to 31 years. All were given an explanation of the study and informed consent was obtained. A battery of color tests including the Ishihara test, the Panel D-15 test, and the anomaloscopic Rayleigh match were used to screen and classify the normal and color deficient subjects. Each subject was then tested with the CVTMET under monocular (OD and OS) viewing conditions. A Macbeth Easel Lamp was used as the light source. All subjects had 20/20 or better visual acuity at near through their habitual near optical prescription, which they wore for testing. The subjects' responses were recorded for each test plate for the right eye and then the left eye.

A Moreland anomaloscope was used to determine colot normalcy or deficiency. This instrument uses the same spectral primaries (i.e., 545 nm, 589 nm, and 670 nm; 2° field size) as the Nagel I anomaloscope, and their matching characteristics are the same.[15] The matching range, midpoint, and the anomalous quotient of our Moreland anomaloscope were previously established with 600 color normal observers. All the color normal subjects in this study passed the Ishihara test and had an anomalous quotient in the normal range of 0.74 to 1.33.[16] Classification of color deficiencies was determined by the red–green matching range and the calculated anomalous quotient.

The CVTMET was administered according to the instructions supplied with the test. Each subject was first shown the demonstration card for the appropriate part of the test. For Part I, the subjects were then shown test cards 1–9 in sequential order. The examiner asked each subject, "Please tell me what you see on each of these cards." For Part II, the subjects were asked, "Please tell me what object you see in each of these cards. Do you see a dog, boat, balloon, car, or nothing?" The cards were held at 75 cm and at right angles to the subjects' line of sight.

The CVTMET's recommended pass/fail criteria were used to determine whether the subjects passed or failed. Correct identification of all shapes on eight of the nine test cards for Part I was considered a "pass"; < 8 of nine correct was a "fail". Correct identification of all three cards was required to pass Part II.

Screening of young children

The CVTMET was also used in a kindergarten vision screening project consisting of 154 school children aged 5 to 7 years. Two of the children were not able to participate in the vision screening because of shyness or crying and thus were excluded. Therefore our sample consisted of 152 children; 52% (79 of 152) were male and 48% (73 of 152) were female. The ethnic distribution was 68.4% (104 of 152) Hispanic, 31% (47 of 152) Black, and 0.7% (1 of 152) White. Age distribution was 27.6% (42 of 152) five-year-olds, 64.5% (98 of 152) six-year-olds, and 7.9% (12 of 152) seven-year-olds. The test site was at an inner city public school in a neighborhood with a low socioeconomic status. Informed consent

TABLE 1.
Plate by plate analysis for the CVTMET; the expected findings are given for color normal and deficient individuals (C = circle, Q = square, S = star, N = nothing)

Plate	Part I (9 plates)									Part II (3 plates)		
	1	2	3	4	5	6	7	8	9	A	B	C
Color normal	CQ	CS	QC	CQ	QC	QC	CQ	CSQ	SC	Boat	Balloon	Dog
R/G deficient	C	S	C	Q	C	Q	N	N	N	N	N	N
Specificity (%) n = 20	100	100	100	100	100	100	100	100	100	100	100	100
Sensitivity (%) n = 21	67	81	86	86	76	76	86	81	81	90	71	81

was obtained from the parents of the children who participated in the screening. All children had 20/30 or better visual acuity at near.

Both Parts I and II were administered to the subjects binocularly and according to the test manual instructions. The demonstration card for each part was used to insure that the child could identify the shapes and pictures verbally. If a child could not respond verbally, he or she was encouraged to point to the shapes or pictures on the demonstration cards. Although the instructional manual suggested that a maximum response time of 3 s per test plate be used, we allowed the children up to about 30 s to respond to the first few test plates. We did this because many children were shy and initially hesitant to respond. Because English was not the child's first language in many instances, we repeated the test instructions when appropriate.

Two general approaches are typically used to assess the validity of color vision tests when administered to young children. Studies either compare the frequency of children identified as color deficient to the prevalence of color deficiency expected in the adult population or compare the results of the test being evaluated to the results of the gold standard test for color vision testing (usually the anomaloscope). Our intent was to use the latter approach –to compare the CVTMET results to the gold standard color test (i.e., the anomaloscope) as well as the standard clinical color vision test (i.e., Ishihara) in adult color deficient and color normal patients.

From a clinical standpoint, the Ishihara PIC test is probably the most widely used PIC test[2, 16, 17] and is considered one of the best screening tests for red–green defects.[2, 16] Its coefficient of agreement (angle Kappa) with the anomaloscope is very high, and has been calculated to be from 0.95 to 1.00.[16] Therefore, our *a priori* criteria for evaluating the CVTMET in color deficient adult subjects was that the CVTMET compare favorably to the anomaloscope and be as good of a color vision screening instrument as the Ishihara test.

RESULTS
Adult subjects

A plate by plate analysis is given in Table 1. Because results from the two eyes were practically identical, only the result from the right eye is reported. The specificity (derived from the color normal subjects) was 100% for all 12 test plates. The sensitivity for each test plate (derived from the 21 color deficient subjects) ranged from 67% to 90%. Therefore, there was no one single test plate that matched the anomaloscope result perfectly.

All 20 color normal subjects passed both Part I and II of the CVTMET. Results from the 21 color deficient subjects for the anomaloscope, CVTMET, Ishihara, and Panel D-15 tests are compared in Table 2. The subjects are grouped according to the four types of hereditary red–green deficiency (protanopia, deuteranopia, protanomaly, and deuteranomaly) as determined by anomaloscopic testing. The pass/fail results from Part I and Part II were identical to each other. All subjects with protanopia, deuteranopia, and protanomalies failed the test. Ten of the 12 deuteranomalous subjects failed and two passed. The two deuteranomalous subjects (no. 20 and 21) who passed the CVTMET also passed the Ishihara and the Panel D-15 tests. These individuals had very mild color anomalies based on the narrow red–green acceptance range they exhibited for the anomaloscopic Rayleigh match.

The 2 by 2 matrix shown in Fig. 2 compares the results of both parts (pass/fail results for Parts I and II were identical) of the CVTMET to the anomaloscopic results. The two cells on the top row of the matrix in Fig. 2 represent the performance of the color

TABLE 2.
The pass/fail results of the Part I and II of the CVTMET, the Ishihara test, and the Panel D-15 test for the 21 color deficient subjects as determined by the anomaloscope; the number of plates failed is listed in parenthesis

Subject	Anomaloscope	CVTME Part I	CVTME Part II	Ishihara	Panel D-15
1. PL	Protanopia	Fail (9)	Fail (3)	Fail (14)	Fail
2. LH	Protanopia	Fail (9)	Fail (3)	Fail (14)	Fail
3. AH	Protanopia	Fail (9)	Fail (3)	Fail (14)	Fail
4. MH	Protanopia	Fail (9)	Fail (3)	Fail (13)	Fail
5. FW	Protanopia	Fail (9)	Fail (3)	Fail (12)	Fail
6. RS	Protanopia	Fail (9)	Fail (3)	Fail (11)	Fail
7. AM	Deuteranopia	Fail (9)	Fail (3)	Fail (14)	Fail
8. KC	Protanomaly	Fail (9)	Fail (3)	Fail (13)	Pass
9. TL	Protanomaly	Fail (9)	Fail (3)	Fail (10)	Pass
10. RH	Deuteranomaly	Fail (9)	Fail (3)	Fail (14)	Fail
11. JK	Deuteranomaly	Fail (9)	Fail (3)	Fail (13)	Fail
12. DE	Deuteranomaly	Fail (9)	Fail (3)	Fail (14)	Borderline
13. SW	Deuteranomaly	Fail (9)	Fail (3)	Fail (14)	Pass
14. TC	Deuteranomaly	Fail (9)	Fail (3)	Fail (12)	Pass
15. MH	Deuteranomaly	Fail (8)	Fail (3)	Fail (13)	Fail
16. DP	Deuteranomaly	Fail (7)	Fail (2)	Fail (11)	Pass
17. JC	Deuteranomaly	Fail (6)	Fail (1)	Fail (11)	Pass
18. DS	Deuteranomaly	Fail (5)	Fail (1)	Fail (6)	Pass
19. MM	Deuteranomaly	Fail (2)	Fail (2)	Fail (7)	Pass
20. SB	Deuteranomaly	Pass (0)	Pass (0)	Pass (0)	Pass
21. SS	Deuteranomaly	Pass (0)	Pass (0)	Pass (0)	Pass

Anomaloscope (Standard)	CVTMET I & II: Pass	CVTMET I & II: Fail
Pass (Color Normal)	20 True Negatives	0 False Positives
Fail (Color Deficient)	2 False Negatives	19 True Positives

FIGURE 2.

Comparison of CVTMET results with responses obtained with the anomaloscope, which was used as the standard (i.e., validation criterion) for classifying a subject as either color normal (pass) or color deficient (fail).

normal adult subjects. True negative results are from those who passed both the anomaloscope and the CVTMET. False positive results are from subjects who failed the CVTMET but were determined to be color normal from anomaloscope testing. Because all the color normals passed the CVTMET, this resulted in no false positives. Therefore, based on our sample, the specificity of the CVTMET is 100%.

The results from the color deficient adult subjects are represented in the two cells on the bottom row of the matrix and show that 19 of 21 color defective subjects were identified as being color deficient by both the CVTMET and the anomaloscope and thus are classified as true positives. The two subjects who were identified as being color defective by the anomaloscope yet passed the CVTMET are classified as false negatives. Therefore, the measured sensitivity of the CVTMET in our sample is 90.5% (19 of 21; 95% confidence interval: 0.70, 0.99).[18] These two subjects also passed the Ishihara and Panel D-15 tests.

Screening of young children

Of the 152 kindergarten children screened, four were identified to be color deficient by both Part I and Part II of the CVTMET. All were males; two were five years old and two were six years old; three were Hispanic and one was Black. This resulted in a color deficiency prevalence of 5.06% (4 of 79; 95% confidence interval: 0.014, 0.125)[18] among the males screened. All four boys who failed followed the exact red–green color deficient response pattern on every plate of the CVTMET. No females were found to be color deficient.

The response patterns from Part I were very consistent, following either the expected normal or expected abnormal response patterns completely, and thus allowing an easy diagnosis. The only exception was on plate 8 where the middle shape (a small star) was initially omitted by several color normal children. However, when questioned further, they were able to identify the star. Incidentally, this is the only card in Part I that has three shapes, all others contain only two. Part II was actually more difficult for some children in that they appeared to have some difficulty recognizing the pictures. Presentation of the demonstration plate and instructions had to be repeated before several children could successfully perform the task.

DISCUSSION

Our study indicates that the CVTMET is a very effective color vision deficiency screener. First, using the anomaloscope as the validation criterion, we found that both parts of the CVTMET had a 100% specificity and a 90.5% sensitivity. Owing to our modest sample size, the 95% confidence interval for the sensitivity measure was calculated to be 0.70 to 0.99; however, it is noteworthy that these CVTMET results were identical to the Ishihara test results in this study. Less than perfect agreement of the Ishihara test with the anomaloscope (i.e., sensitivity) has been reported by other investigators as well[16]; yet, the Ishihara is considered by many to be one of the best[2, 16] and most popular[2, 16, 17] PIC color vision tests for clinical use. Second, our adult protanopic, deuteranopic, and protanomalous subjects followed the expected red–green deficient response pattern exactly which allowed for a straightforward diagnosis. Third, of the 12 deuteranomalous subjects, eight of them passed the Panel D-15 test, indicating that their color vision defects were mild. Yet, the CVTMET correctly identified six of these eight subjects as color deficient. The two deuteranomalous subjects who passed the CVTMET were found to have the mildest deuteranomalies among the color deficient subjects as evidenced by having the most narrow red–green acceptance range on the Rayleigh match. Because these two subjects also passed the Ishihara test, their mild color defects would not have been detected in most eye care offices. The only time that they would be identified would be when a more sensitive test such as the anomaloscope was used. From the perspective of a color screening test, this error would be acceptable because individuals with mild deficiencies such as these usually do not manifest color vision–related problems.

Despite the identical results obtained from the CVTMET and the Ishihara tests, there are some differences. Unlike the Ishihara test, the CVTMET does not allow the differentiation of protan from deutan. Because the Ishihara test has been validated by numerous investigations and is the clinical standard test for color vision screening, we see no distinct advantage in using the CVTMET to replace the Ishihara for screening older children and adults in a standard clinical setting. The usefulness of the CVTMET, however, may be in screening those who cannot perform the Ishihara test because of the necessity for the patient to know his or her numbers or have the fine-motor ability to trace them accurately. These patients would include most children in pre-school and kindergarten as well as older children and adults with developmental disabilities. The simple design of the CVTMET is particularly suitable for young children who typically can identify and name geometric shapes such as a circle, square, and star; and pictures such as boat, balloon, and dog by the age of 3 years. For children who can not or will not respond verbally, one can easily use the demonstration plates to make the task one of matching.

Because the results from Parts I and II of the CVTMET were found to be the same, either part may be used by itself. Part II, because of the 3 plate design, may be especially attractive for those wanting to test young children or large numbers of individuals. Typically, it took < 1 min to test the children in our study on Part II. There are, however, some potential considerations if one wishes to use only Part II for screening young children.

Because the expected color deficient response for the three cards in Part II is "nothing," results are equivocal when a young child responds that he/she sees "nothing" (or more commonly just looks and does not respond verbally at all). This could indicate that a color deficiency is present or alternatively, that the child does not understand the task. Whereas in Part I, a color defective individu-

al's response on plates 1 to 6 is to see one of the two shapes on the test card; the reporting of one shape but not the other allows the tester to distinguish with confidence the color normal from the color deficient person. Therefore, we would recommend that if Part II is used to screen young children, that Part I be administered in instances when a child fails Part II. If the child does not respond to Part I as well, then there is probably a lack of understanding on the child's part. If the child failed Part II because of a color deficiency, then he/she should give the expected color deficient responses on Part I. In using this suggested testing protocol, Part I then is used to confirm the diagnosis of color deficiency. This same protocol would be appropriate when performing large scale vision screenings on individuals of all ages.

It is interesting that the 5.06% frequency (4 of 79) of color deficiency found among the boys in our sample is about the same as what one would expect to find in older children or adults of the same ethnicity. The United States Health Examination Survey findings for the prevalence of color deficient male children 6 to 11 years of age is 6.95%[19] and the United States Health Examination Survey in American youths 12 to 17 years of age is 7.53%.[20] The prevalence rates are slightly less for Black boys aged 12 to 17 years (6.35%)[20] and significantly less (4.04%) for boys aged 6 to 11 years compared with White boys.[19] The prevalence for 12- to 17-year-old boys of "other races" was 5.34%.[19] The 5.06% frequency of color deficiency found in our sample of Hispanic and Black boys, therefore, compares favorably to what one would expect to find in older boys of the same ethnic groups. It should be noted, however, that a sample size of 152 children (with 79 boys) is not considered sufficient to establish color deficiency prevalence rates and that the 95% confidence interval was calculated to be 0.014 to 0.125.

In addition to comparing favorably to the anomaloscope and Ishihara test in adults, the CVTMET is well understood and accepted by 5- to 7-year-old children. The format and cognitive skills required of the CVTMET were well within the capabilities of the kindergarten children that we tested. The majority had little difficulty in performing the task, with the exception of the tester sometimes having to repeat the instructions when the child did not appear to understand. In addition, the response patterns of the normal and color deficient children were very clear-cut so that the diagnosis was made with a high degree of confidence.

In summary, the results of our investigation of the CVTMET indicate that the test appears to be just as sensitive as the Ishihara test in identifying red–green color deficiencies in adults. In addition, the CVTMET has excellent utility in identifying kindergarten children ages 5 to 7 years who have red–green color deficiency which might result in educational disadvantage.

ACKNOWLEDGMENTS

We would like to acknowledge Paul DeLand, PhD, who provided suggestions during the review process and Terry Waggoner, OD, who designed and supplied the Color Vision Testing Made Easy® test that was used in this study. The authors have no financial interest in the Color Vision Testing Made Easy® test.

Presented in part at the 1996 annual meeting of the American Academy of Optometry, Orlando, FL; December 14, 1996.

Received September 17, 1997; revision received June 8, 1999.

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Susan A. Cotter
Southern California College of Optometry.
2575 Yorba Linda Blvd.
Fullerton, CA 92831