



Dr. Israel Dvorine's Criticism of the HRR: A Letter to the Inter-Society Subcommittee on Color Blindness

Dear Sir:

I am herewith submitting pertinent facts regarding the HRR color plates, which may be of interest to your consultants who are evaluating them and are comparing them with the Dvorine plates.

The data which forms the basis for this presentation has been taken from the following published reports:

"Evaluation of HRR Plates for Measuring Degree of Red-Green Color Deficiency," by Louise L. Sloan and Adelaide Altman. Technical Report-Project N60NR 243-07.

"Comparative Evaluation of the Hardy-Rand-Rittler Polychromatic Plates for Testing Color Vision," by Ingeborg Schmidt, Project #21-31-013 USAF School of Aviation Medicine.

"H-R-R Polychromatic Plates," by Hardy, Rand and Rittler, Journal of the Optical Society of America, Vol. 44, Number 7, July 1954.

The authors of the HRR Plates state that their test, "goes beyond the mere separation of subjects with defective color vision from those whose color vision is normal, in that it also classifies the type of defect present and estimates its amount."

Since the Dvorine plates also separate subjects with defective color vision from those whose color vision is normal, and since they also differentiate the protans from the deutans, the only so-called advantage of the HRR plates is their claim that the latter also estimates the degree of the color defect, which they classify as "mild," "medium," and "strong."

This special feature of the HRR plates has been evaluated by Dr. Sloan. In her report she wrote as follows:

"There is, however, experimental evidence suggesting that, for certain occupations, only subjects having very slight degree of color deficiency are qualified. For example, field studies at the AF School of Aviation Medicine, involving identification of color light signals of various sorts, lead to the adoption of a qualifying score of 50 on the CTT (Color Threshold Test) for certain assignments in the Air Forces."

"The HRR test, in its present form, does not provide classifications to meet these relatively stringent standards. The data on Table 4 for example, show that of 25 subjects having a "Mild" defect, eleven score less than 50 on the CTT."



"The fact that subjects in the "medium" category show varying degrees of defect on other tests suggests that the HRR test distinguishes reliably only two rather than three grades of defect, "

And finally, Dr. Sloan concludes with these pertinent remarks:

"It is possible that the rating of color deficient subjects according to degree of defect, may show reliable and significant differences on tests involving different stimulus-variables. "

If we take note of the fact that the present edition of the HRR plates contain only two color charts (15 & 16) for the identification of "strong" color blinds, the quantitative advantage of the HRR plates over the Dvorine plates does not appear so formidable.

The authors make no reference to any corrective measures taken by them to meet this serious criticism of their plates by a member of the Inter-Society Color Council Sub-committee. The only reference they make to changes or improvements refer to "defects" in registration and "improvement in the design and arrangement of the symbols and their backgrounds. "

These changes refer only to the mechanics of printing technique which calls for accurate registration in any good printing job. No reference is made regarding changes in the color of the inks to improve the effectivity of the plates, yet the color of the ink is the important factor in this test.

It is interesting to note here that the reference to background changes stems from a criticism of the plates by Dr. Schmidt. Here is what she wrote in 1952:

"As stated by the authors, care will be taken in the final print to make all background patterns identical so that they will furnish no clues for memorization."

The authors could have saved the expense of changing the background of their plates had they inspected the first edition of the Dvorine plates published in 1944, in which the identical background pattern for pseudo-isochromatic plates was first introduced.

Even on the relatively simple differentiation of the color blind into protans and deutans, we find the HRR test to be vulnerable. The authors claim that,

"As a device to classify subjects with defective red-green vision into deutans and protan types, the HRR test is about as successful as the Nagel anomaloscope test (The HRR test being successful in 97 percent of the 150 subjects and the anomaloscope in 98 percent)."

Dr. Sloan, in her study of 65 color defectives found that, "Four subjects could not be classified as to type of defect by the HRR test. There were 8 instances in which the responses to individual plates of the HRR series were not in accord with the classification " as to type based on the entire series, and on other tests.

One other advantage is being claimed for the HRR test and that is in the permanency of the inks. The authors state,



"One of the most serious defects of printed tests for color vision has been the impermanence of the colors and their deterioration with age. This is an inescapable factor in all printing involving the use of linseed oil inks. Another serious defect is the variability of the color with succeeding copies in a production run. Both these defects, we are assured by our color consultant, Mr. Foss, have been satisfactorily overcome in this set of plates in which specially compounded inks have been used. "

One wonders if this type of proof of permanence would be considered sufficient for military experts if they were buying the inks instead of the printed plates. Where is the evidence of exposure to the Fadeometer and the results of comparative tests with other color plates in which linseed oil was used as a mixing agent? Where is the evidence of comparative tests conducted with different inks on various paper stock? For how long is the permanence of the HRR inks guaranteed and what is the basis for this guarantee? Do government experts accept the personal assurance of an individual when they are buying paints, a pigment close in analogy to colored inks?

There are a number of gross disadvantages in the HRR plates which warrant their inclusion in this factual report.

The red-green screening group is limited to 6 plates. Plates 5 and 6 however, are to select the blue-yellow blind only. Dr. W.D. Wright, world famous researcher in color vision, estimates that the percentage of tritanopes (blue-yellow blind) among the male population is 0.0001. ("Researches on Normal and Defective Color Vision," page 303.)

As for tetartanopia, another group of blue-yellow blind, Forrest L. Dimmick, a member of the ISCC Subcommittee on Color Blindness, has this to say,

"Tetartanopia: Form of dichromatism in which blue and yellow stimuli are confused. The existence of this form is disputed. "Color Terms and Definitions," Optical Developments, April, 1949."

Thus, we find that of the six screening plates of the HRR, two of them (5 & 6) are suitable for only 0.0001 of the male population. Yet the authors say,

"If no errors are made in this series (1 to 6), the color vision of the subject is classified as normal and no further plates of the test need be administered. " (HRR Instructional Manual).

Memorizing the three symbols of four plates should not be too difficult a task for one who is determined to pass the test, even if the book is turned upside down or sideways. The symbols remain in their relative positions if the binding or punched out holes are used as a reference point.

Dr. Schmidt has this to say regarding memorization of the HRR plates:



"Learning the designs would be easier for the color defective than on other plate tests since the HRR charts must be presented in a definite order."

Another gross disadvantage of the HRR plates is in the use of a common gray background for all plates. The authors state that,

"The hues and values for the protan and deutan types of red-green deficiency were carefully adjusted experimentally to the average neutral points of a group of dichromatic subjects of these two types."

In "The Science of Color," a book published by the Committee on Colorimetry of the American Optical Society of America, we find on pages 136 and 137 that only 1 percent of the color defectives are dichromats. Dr. Wright gives the percentages as follows: protanopia 1.2 percent and deuteranopia 1.4 percent.

To meet this challenge, the authors of the HRR test express the fond hope that,

"This procedure (uniform gray background) is based on the assumption that the hues which are critical for the dichromatic subject of each type will be hues to which the anomalous trichromat of each type has reduced sensitivity."

This statement is made in spite of Dr. Schmidt's report:

"failing the screening series (of the HRR test) does not necessarily indicate a color defect and passing the classification series does not necessarily indicate normal color vision."

In addition to this, Dr. Schmidt found that,

"In giving answers for the HRR charts it is easy to make errors that are purely verbal. Such errors are more likely to occur when the entire test is given and when normal or persons with a mild defect are tested.

On the question of luminosity for the HRR plates the instructions are specific:

"It is mandatory that this test be administered under illumination of C.I.E. Source C, or a close approximation thereto, with an illumination intensity between 10 and 60 foot-candles. "

How many ophthalmologists, optometrists and psychologists have this type of illumination in their offices? How many would spend the extra \$35 to equip themselves with this light? Since the effectivity of the light depends on the exclusion of all other light, is there sufficient justification for the expense of equipping military installations with dark rooms in addition to the cost of the HRR plates which is almost double the price of Dvorine plates?

In a report published in the May issue of the American Journal of Optometry there is an evaluation of the Dvorine plates when they are used in a light environment common to most professional offices. The only additional light source was a 100-watt daylight blue bulb placed in

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a convenient location to give added illumination to the charts. The number of misclassifications for the normals as well as for color defectives was extremely low and no higher than were found by other investigators who used pseudo-isochromatic plates illuminated with the Macbeth lamp or similar type of illumination.

Finally, there is still one more question which needs to be answered. If the HRR plates are open to serious criticism as this report indicates, why did the Inter-Society Subcommittee on Color Blindness approve the HRR plates and not the Dvorine plates, which have been accepted by the American Medical Association?

The question of approval is still before the ISCC committee, but the chairman, Dr. Deane B. Judd, has written to me as follows on March 2nd, 1955:

"I doubt whether their decision will be to sanction the use of the ISCC initials in connection with the promotion of the Dvorine Pseudo-Isochromatic Plates. The reason for my doubt is that the policy so far has been to sanction such use only in connection with tests springing directly from the work of ISCC subcommittee.

In other words, the committee approves only works that are developed by members of its own committee. This is extremely unfortunate for manufacturers or publishers of other Pseudo-isochromatic plates not marketed by the American Optical Company, for one of the specifications to qualify to bid on military orders for pseudo-isochromatic plates is that the said plates must be approved by the Inter-Society Color Council Subcommittee on Color Blindness.

It is interesting to note that the three authors of the HRR plates, Dr. Hardy, who died last year, was a member of the ISCC Subcommittee and that the list of members who approved this work contains the names of Dr. Gertrude Rand, co-author of the HRR plates, and Carl E. Foss, who had charge of production of the plates.

As for the propriety of such action by a group of scientists who actively participated in the development and production of a commercial item, then approve their own work and sanction the use of the good name of their organization for promotion purposes, I shall let the foregoing facts speak for themselves.

Respectfully yours,
Israel Dvorine, O.D.