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PSYCHO-PHYSICAL ANALYSIS OF THE BETTS VISUAL ACUITY TEST

H. C. SCHEPLER

Although visual acuity is of chief concern to the optometrist from the professional standpoint, the physicist should be no less concerned from the standpoint of its applications to work in optics and illumination.

Visual acuity is indeed difficult to measure and many types of acuity tests have been devised. The Clason acuity meter and the Snellen chart are the accepted standards used by optometrists. Another test for measuring acuity, which is administered on the stereoscope, is one of many visual tests that has been developed by Betts, Director of Teacher Education, State Normal School, Oswego, N. Y., who worked jointly with the Keystone View Company of Meadville, Penna. (Fig. 1.) The principle of the test is

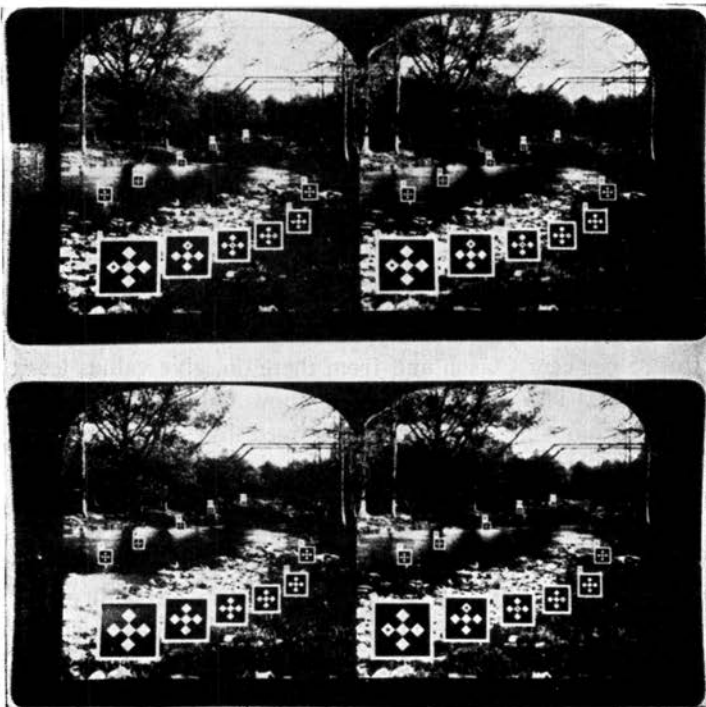


Figure 1

the ability to resolve a black dot set within a target when the card is placed in a stereoscope.

From tests made with the Betts cards, curves were obtained showing the relationship between the standard Clason acuity values and the acuity as determined by the Betts slides. Measurements were made on 5000 cases in connection with automobile drivers' tests given in several states. (Fig. 2.) The theoretical relationship

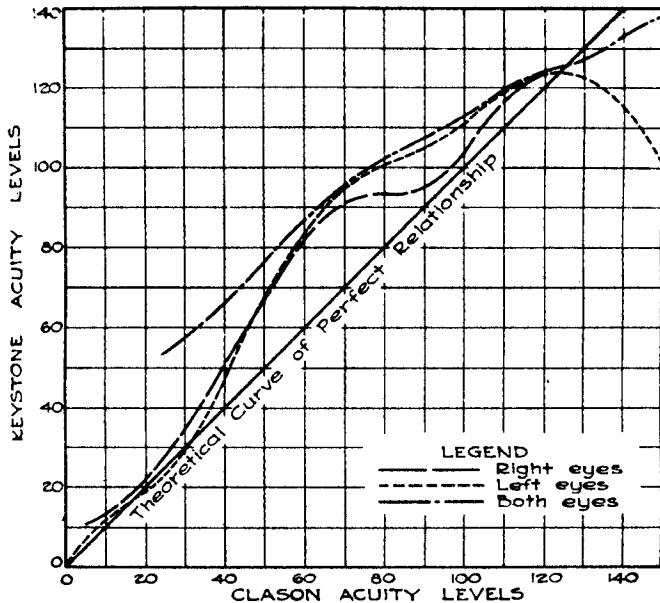


Figure 2

between the two tests is a straight line. Curves obtained using the original Betts cards give acuity values greater than Clason values up to 125 per cent Clason and from there on, give values less than the standard. The curves, however, show only the general trend of comparison since they were obtained by smoothing straight line point-to-point curves.

(Fig. 3). A similar set of curves using the new revised Betts cards show the two levels to correspond at 40 per cent Clason. The Betts values fall below the Clason for percentages above 40 for the right and left eyes, but does not do so for both eyes until 80 per cent Clason is reached. In the original designs, the dot sizes indicated for the ordinary tests at twenty feet (the Clason test distance) were reduced to 1/47 size photographically. From experimental results with the original cards, the reduction was

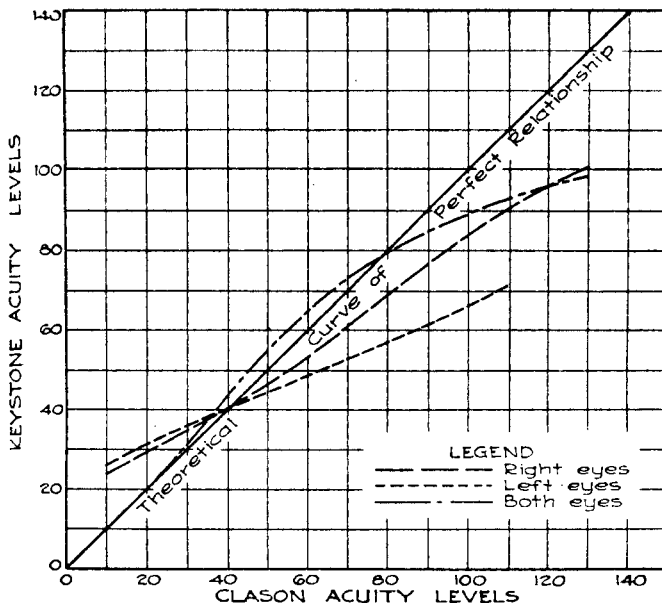


Figure 3

changed to $1/40$ for the new cards. But still the test values do not correspond as shown by the curves obtained with the new cards.

A thorough analysis of the Betts cards was made to determine the reason for the shape of the relationship curves, to find how much these tests were in error, and to aid in designing an acuity test for use on the stereoscope that will give comparable results with the standard acuity measurements. Measurements were made of the diagonals of the targets (their largest dimension) (Fig. 1), of the separation between targets, and of the dot diameters. The latter were microscopic measurements and were found to be of most value.

Statistical evidence regarding the test in general could not be obtained since only one set of cards was available for measurement. It is reasonable to assume that there will not be any great variation between these test cards and others, but even then the differences may be too great to permit generalization.

In measuring the dot diameters the constant error was determined and expressed in percentage of corresponding dot size. The per cent error in measurement varied from 0.3 per cent for the largest dot to 7.95 per cent for the smallest dot. The final dot diameters recorded were the averages of five microscope settings except for dots in targets 6 and 7 where the averages of fifteen read-

ings were recorded. The measurements showed that the dot in target 6 is actually smaller than that in target 7 while it should be much larger. This error also showed up in the comparative tests from which the smoothed curves were drawn.

The relative dot diameters were calculated from the per cent Clason equivalents and these were compared with the actual dot diameters as measured with the microscope. Considering the levels to be equivalent where the curves cross the theoretical line at 40 per cent Clason (Fig. 3) the per cent error for each dot was calculated. It was found that for the average values, three dots were in approximately 2 per cent error, two in 8 per cent error, four in 15 per cent error, and two in 22 per cent error.

The conclusions to be drawn, then, are that the test does not give accurate acuity values as compared with standard measurements, but that the test may still be useful for obtaining a rough estimate of a person's acuity condition.

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