Comparison of Farnsworth and Lanthony D-15 Color Vision Tests to an Computerized Color Vision Cap Rearrangement Test

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Comparison of Farnsworth and Lanthony D-15 Color Vision Tests to an Computerized Color Vision Cap Rearrangement Test

Description
Inherited color vision deficiency affects approximately 8% of the male Caucasian population, 5% of non-Caucasian males, and 0.4% of all women. In addition, significant numbers of patients of both genders acquire color vision loss due to ocular disease or pharmaceutical medications.

Yet in many clinical settings color vision testing presents a challenge because plate tests, like those designed by Ishihara, do not easily differentiate green (deutan) from red (protan) defects. Tests that do differentiate, like the Farnsworth D-15, show false positive results with mild to moderate anomalous trichromacy, and are time-consuming. In addition, both require proper lighting to administer.

To screen for color vision deficiencies, and accurately diagnose them when they are found, a reliable automated test would be desirable, as it could be run by technicians and aid the optometrist in interpretation.

Disciplines
Optometry

Comments
Poster presented at American Academy of Optometry meeting in 2006.

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INTRODUCTION
Inherited color vision deficiency affects approximately 8% of the male Caucasian population, 5% of non-Caucasian males, and 0.4% of all women. In addition, significant numbers of patients of both genders acquire color vision loss due to ocular disease or pharmaceutical medications.1 Yet in many clinical settings color vision testing presents a challenge because paper tests, like those designed by Ishihara, do not easily differentiate green (deutan) from red (protan) defects. Tests that do differentiate, like the Farnsworth D-15, show false positive results with mild to moderate anomalous trichromacy, and are time-consuming. In addition, both require proper lighting to administer.2 To screen for color vision deficiencies, and accurately diagnose them when they are found, a reliable automated test would be desirable, as it could be run by technicians and aid the optometrist in interpretation.

METHODS
152 eyes of 76 healthy young adults (44 male, 32 female; overall average age 24.6 years, range 21-38 years) were administered both the traditional cap versions of the Farnsworth (saturated color) and Lanthony (desaturated color) D-15 color vision tests. The tests were performed monocularly with habitual corrective lenses in place. Lighting was provided by an illuminant C filtered Macbeth Easel lamp, and the results recorded. One week later, a second investigator, masked to the results on the first session, repeated an automated, computerized version of both color vision tests. The software used for the comparison was the Color Vision Recorder (version 3) from Optical Diagnostics (http://www.opticaldiagnostics.com). The tests were administered using a Dell desktop CRT monitor that was calibrated according to the software manufacturer's instructions.

RESULTS
SATURATED COLOR TESTS
For the conventional Farnsworth D-15 cap test, classification of a color deficiency depends on recording the subject’s responses on the standard backwards C-shaped graph by hand, a time-consuming process. The cap test showed 141 eyes (93%) with normal trichromacy, and 11 eyes (7%) with defective color vision (severe anomalous trichromacy or dichromacy). The computerized version of the Farnsworth D-15 test completes the graphing and analysis automatically. This test showed 146 eyes (96%) with normal trichromacy, 4 eyes (3%) with unclassified anomalous trichromacy, and 2 eyes (1%) with dichromacy (protanopia). All of the eyes that failed the Farnsworth (saturated color) also failed the Lanthony (desaturated) test.

A computerized Lanthony D-15 testing showed 124 eyes (82%) with normal trichromacy, 26 eyes (17%) with unclassified anomalous trichromacy, and 2 eyes (1%) with dichromacy (protanopia). Of all the eyes that failed the Farnsworth (saturated color) also the Lanthony (desaturated) test. However, of the 28 color-defective eyes identified by the software Lanthony test, only 20 eyes tested as color defective with the traditional cap version of this test, resulting in zero false positives. However, there were 5/11 (45%) false negatives. Nonetheless, chi-square analysis shows that there is no significant difference in the results of the two tests, $\chi^2(1) = 1.56, p = 0.212$.

DESATURATED COLOR TESTS
When testing normal trichromats, the Color Vision Recorder software demonstrated accuracy compared to the traditional cap version. 45% with the automated Farnsworth and 41% with the automated Lanthony. In addition, the automated Lanthony test had 24% false positives. There were advantages to administering the Color Vision Recorder D-15 tests, including shorter time to administer, accurate recording, and, when accurate, more straightforward diagnosis of color vision deficiency. However, monitor calibration, test familiarity, and other factors may interfere with its accuracy compared to the traditional cap versions of the D-15 tests.

CONCLUSION
When testing normal trichromats, the Color Vision Recorder software demonstrated accuracy in assessing color vision deficiency within 3% of the traditional Farnsworth (saturated) D-15 cap test, and within 5% of the traditional Lanthony (desaturated) D-15 cap test. When testing color-deficient subjects, there were a significant number of false negatives, 45% with the automated Farnsworth and 41% with the automated Lanthony. In addition, the automated Lanthony test had 24% false positives.

FINANCIAL DISCLAIMER
The authors have no financial interest in Optical Diagnostics or this software.

REFERENCES