



The Color Vision Testing Suite

Clinical Studies and Validation  
of Waggoner Computerized Color Vision Test

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## **Clinical Research & Studies: Waggoner Computerized Color Vision Test**

### **Waggoner Computerized Color Vision Test Description**

The Waggoner Computerized Color Vision Test (WCCVT) was created as an all-in-one color vision testing suite to satisfy anyone interested in testing for color vision deficiencies ranging from school nurses to the U.S. Military. Within the WCCVT, an individual can choose several different testing methods that includes screening, diagnostic, pediatric, and adult testing. The Adult Diagnostic test provided in the WCCVT software is the cutting edge in color vision testing. It has been coined one of three "precision" color vision tests available today by the U.S. FAA. It is a military-grade color vision test that is accepted by the U.S. Navy, Army, and Coast Guard for all personnel and applicants, including pilots. The diagnostic tests are perfect for identifying both genetic and acquired color vision deficiencies and then providing the type and severity of the deficiency. Color Vision Testing Made Easy is included in the application and is the gold standard for pediatric color vision testing and is used to screen participants at the World Special Olympics to this day. Due to formalities, we have included the D-15 even though this test has been shown to have lower sensitivity and specificity than our diagnostic tests included in the WCCVT.

### **Waggoner Computerized Color Vision Test Validation & Research Use**

Chidester, T., Milburn, N., Peterson, S., Gildea, K., Roberts, C., & Perry, D. (2013, September). Development, Validation, and Deployment of a Revised Air Traffic Color Vision Test: Incorporating Advanced Technologies and Oceanic Procedures and En Route Automation Modernization Systems. Office of Aerospace Medicine: Federal Aviation Medicine.

#### **Summary:**

The Aerospace Human Factors Research Division (AAM-500) of the Civil Aerospace Medical Institute developed the Air Traffic Color Vision Test (ATCOV) to determine whether individuals with color vision deficiencies (CVDs) have adequate color vision to perform critical color-related tasks involved in air traffic control. New research was required to integrate Advanced Technologies and Oceanic Procedures (ATOP, or Ocean21) and En Route Automation Modernization (ERAM) display systems into the ATCOV. The research team conducted a study to validate the addition of Ocean21 and ERAM items into ATCOV subtests. Several validated Waggoner color vision tests were used in this study to help detect color vision deficiencies, including the Waggoner PIP24, Waggoner HRR, and Waggoner CCVT.

Gao, H., Reddix, M., Williams, H., & Kirkendall, C. (2013, May). *Can Computer-Based Color Vision Test Results Predict Performance of Operational Environments?* Presented at the 84th Aerospace Medical Association Meeting, Chicago, IL.

#### **Summary:**

The objective of this study was to assess and compare diagnostic capabilities of 3 computerized color vision tests and provide support for these tests by reviewing the scores against human performance tasks. While the detailed results of this study cannot be shared due to confidentiality regarding the Navy, the Waggoner CCVT is now an accepted color vision test by the U.S. Navy.



Makunyane, P. (2016). An update on diagnostic tests for colour vision defects in individuals working in the aviation industry : Back to basics. *Back to Basics. Occupational Health Southern*, 22(3), 12–16.

**Summary:**

The purpose of this study was to provide an update on colour-vision tests approved by the International Civil Aviation Organization and to highlight the importance of choosing appropriate colour-vision tests that can be used with confidence to detect colour-vision deficiency, as well as to classify the type of deficiency involved, and to quantify the severity of loss. Based on this thorough review, the authors recommend using either the Waggoner HRR or Waggoner PIP24 as a screening tool and the Waggoner CCVT as a secondary precision test.

Milburn, N., Chidester, T., Peterson, S., Roberts, C., Perry, D., & Gildea, K. (2013, May). *Pilot Color Vision Research and Recommendations*. Presented at the Aerospace Medical Association.

**Summary:**

This presentation explains the color vision test process, exceptions, procedures, and color vision tests that can be used by aviation medical examiners according to the FAA.

Ng, J. S., Self, E., Vanston, J. E., Nguyen, A. L., & Crognale, M. A. (2015). Evaluation of the Waggoner Computerized Color Vision Test. *Optometry and Vision Science*, 92(4), 480–486.

**Summary:**

A sample of subjects with ( $n = 59$ ) and without ( $n = 361$ ) color vision deficiency (CVD) were tested on the CCVT, the anomaloscope, the Richmond HRR (Hardy-Rand-Rittler) (4th edition), and the Ishihara test. The CCVT was administered in two ways: (1) on a computer monitor using its default settings and (2) on one standardized to a correlated color temperature (CCT) of 6500 K. Twenty-four subjects with CVD performed the CCVT both ways. The screening performance of the CCVT was good (95% sensitivity, 100% specificity). The CCVT classified subjects as deutan or protan in agreement with anomaloscope 89% of the time when administered using the Waggoner CCVT online. Conclusions drawn from this study are that the Waggoner CCVT is an adequate color vision screening test with several advantages and appears to provide a fairly accurate diagnosis of deficiency type.

Quiroz, J., Ng, J., Eum, S., Trevathon, A., Tran, C., & Self, E. (n.d.). *Evaluation of the Waggoner Computerized Color Vision Test*. Presented at the Western Psychological Association, Reno, NV.

**Summary:**

The purpose of this presentation is to evaluate whether the Waggoner CCVT can accurately screen color vision deficiencies. The study included 305 participants. All of the normal trichromats were classified as normal by the WCCVT and D-15 test, whereas 1 and 8 normal trichromats were classified as color vision defective by the Ishihara test and HRR test, respectively. All the 4 tests classified 3 “very mild” color vision defectives as normal trichromats, who were detected only by the anomaloscope. The WCCVT and the HRR test correctly identified the remaining 12 color vision defectives, whereas the Ishihara test missed 1 more and the D-15 test missed 5 more. Among the four color vision tests evaluated, the D-15 test is inferior in sensitivity and the HRR test is inferior in specificity. The WCCVT and the Ishihara test perform well in both of these measures. Considering the ease of administration, the WCCVT is seen as a very promising color vision screening test.



Reddix, M., Kirkendall, C., Gao, H., O'Donnell, K., Williams, H., Eggan, S., & Wells, W. (2014, March). *Assessment of Color Vision Screening Tests for U.S. Navy Special Duty Occupations*. Presented at the 85th Aerospace Medical Association, San Diego, CA.

**Summary:**

The objective of this study was to compare the diagnoses of two current and four proposed color vision tests against the HMC-RT anomaloscope. In addition, the study was completed to assess the degree to which the severity of a color vision deficiency affects human performance in aviation-related tasks. There were 191 participants in the study that were military personnel. The three computerized color vision tests used in the study have near equal sensitivity, which includes the Waggoner CCVT.

Rings, M., Picken, D., & Waggoner, T. (2014, March). *Validation of a Computerized Color Vision Test*. Presented at the Aerospace Medical Association, San Diego, CA.

**Summary:**

As the title points out, this study was completed to validate the Waggoner CCVT. The Waggoner CCVT was compared against the Nagel anomaloscope with 300 participants, 236 has normal color vision and 64 had a color vision deficiency. The Waggoner CCVT had a 100% sensitivity and 100% specificity. The Waggoner PIP24 was also used in this study and had a 100% sensitivity and 89% specificity.