OPERATIONAL BASED VISION ASSESSMENT COLLABORATIVE RESEARCH: AUTOMATED STEREO TESTING

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OBVA Research Objectives

- Quantify the relationship between visual capabilities and performance in simulated operational tasks

- Establish aeromedical vision standards according to current operational requirements

- Modernize aircrew vision screening

Automated Vision Testing (AVT) Development Objectives

- Develop adaptive, threshold-based screening methods

- Prevent memorization, "test preparation," coaching, etc.

- Provide precise quantification beyond "pass/fail" criteria

- Develop automated tests for acuity, contrast sensitivity, color, stereo, fusion range, motion perception, etc.

- Collect normative data for new automated tests

Stereo Acuity Testing Research

- Develop candidate, automated stereo acuity tests

- Improve stereo acuity testing

- Prevent use of monocular cues

- Good stereo/ocular alignment may be more critical w/use of vision enhancement devices

Methods

- USAFSAM and DSO OBVA Labs evaluated two different automated stereo acuity tests developed by USAFSAM

- E-Titmus designed to be similar to standard booklet type stereo acuity test

  - Evaluated standard scoring method, threshold method, crossed-only, uncrossed only, and more difficult bi-directional (crossed or uncrossed)

- "Dual Ring" stereo test designed to prevent use of monocular cues, bi-directional only

- Apparatus: Windows PC, Nvidia 3D Vision2 3D monitor

Figure 1. E-Titmus stereo acuity test stimulus (left), diagram illustrating binocular disparity of test stimuli (center), dual ring stereo acuity test stimulus.
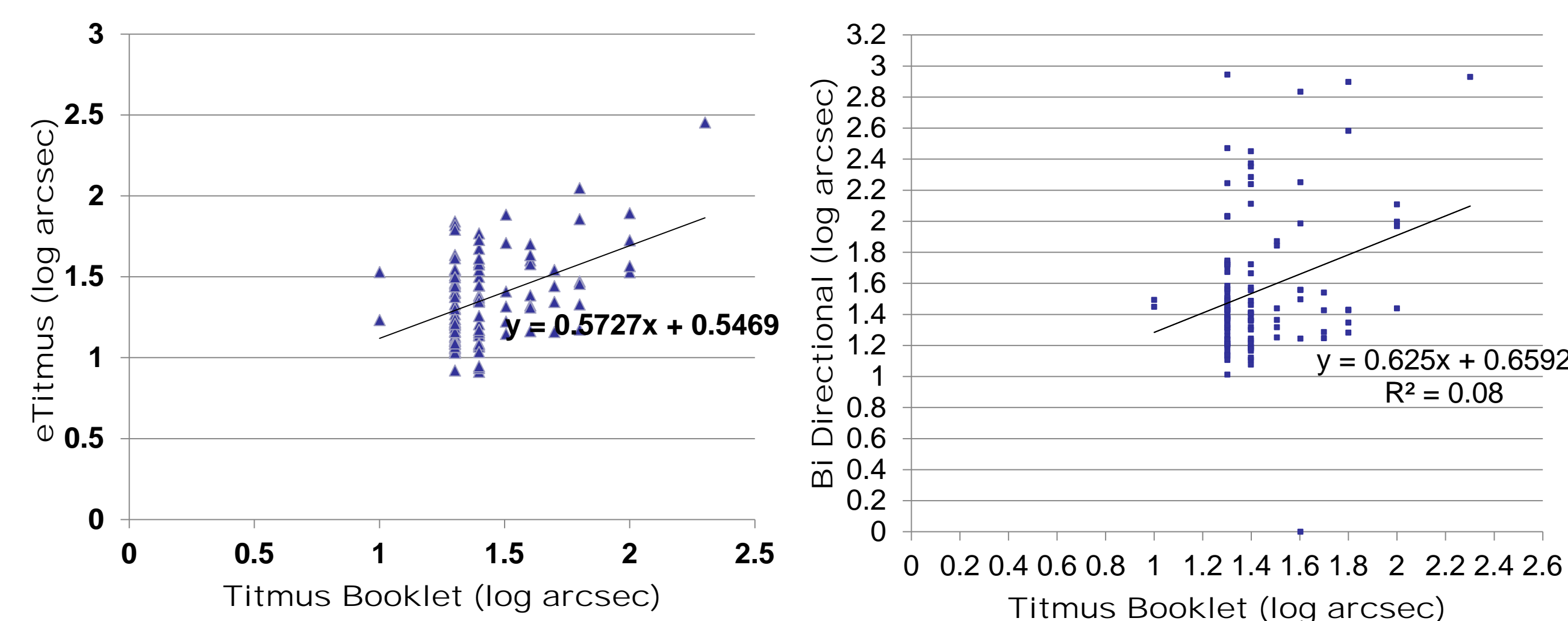
E-Titmus Results

Figure 2. Left: Correlation between E-Titmus crossed with Titmus booklet in log arcsec (n=108), Right: Correlation between E-Titmus bi-directional with Titmus booklet.

Table 1. Repeatability and Reliability Analysis of E-Titmus

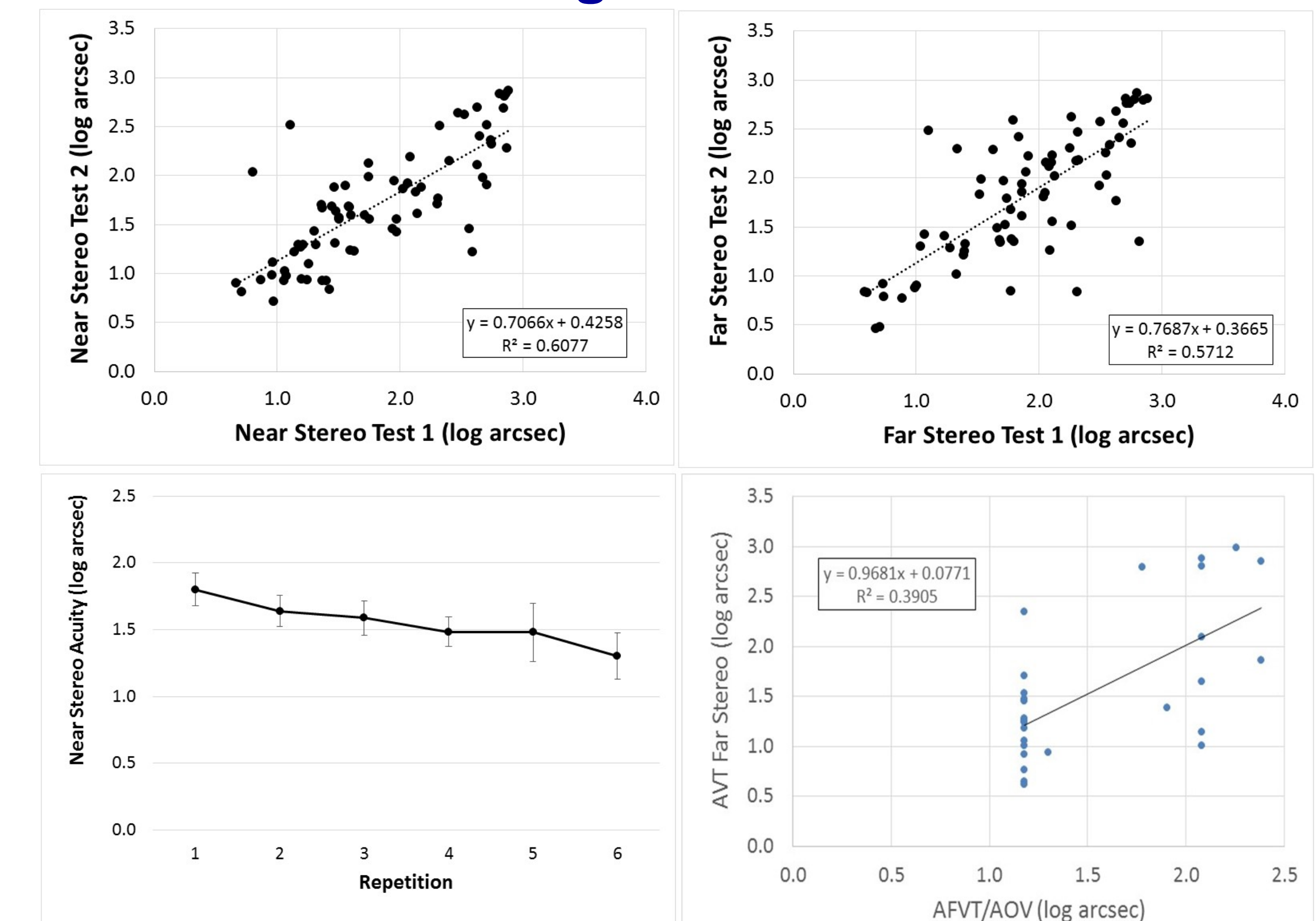|	Cronbach's Alpha	R	ICC	p-value
Crossed	0.739	0.720	0.676	0.083
Uncrossed	0.609	0.448	0.627	0.163
Ave bi-directional	0.987	0.975	0.977	0.001*
Log cross	0.870	0.836	0.828	0.022*
Log uncross	0.677	0.525	0.679	0.120
Log ave bi-directional	0.925	0.891	0.933	0.003*
Titmus booklet	1	1	1	<0.001*

Dual Ring Stereo Test Results

Figure 3. Clockwise from upper left: Test-retest for near stereo acuity (n=73), far stereo acuity (n=73), practice effect for near stereo (n=30), and relationship between AVT and AFVT stereo tests (n=27).

Stereo Acuity and Operational Performance

- Remote vision system (RVS) aerial refueling

- Existing vision standards may be inadequate for properly screening RVS boom operators

- AVT stereo acuity predicted RVS refueling performance while standard AFVT stereo test did not

Conclusions

- Existing standard stereo tests may not truly test stereo acuity due to monocular cues

- Threshold level stereo test avoids quantization, ceiling effects

- Further evaluation of test-retest, practice effects needed

Future Research

- Compare and refine candidate tests
- Identify stereo test(s) predictive of operational performance
- Commercialize AVT, including stereo acuity test – modernize military vision screening