

Validation of a Computerized Color Vision Test

Program ID# 289

Eye Department
Naval Aerospace Medical Institute

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Disclosure Information

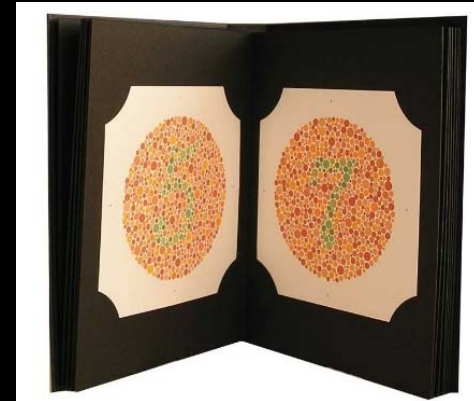
85th Annual Scientific Meeting

CAPT Matthew Rings, MC, USN

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Current Color Vision Tests US Navy

- Pseudoisochromatic Plates (PIP)
 - “Any Red- Green color test”
- Currently use of “PIP Ishihara Compatible” test



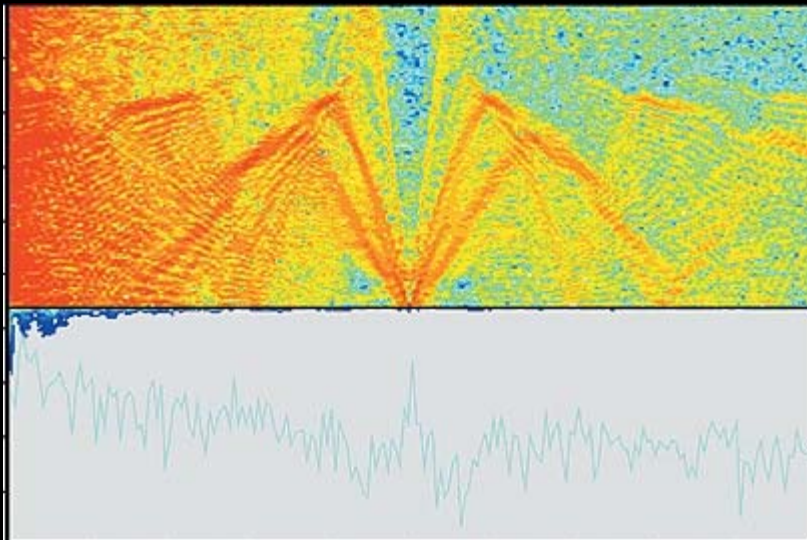
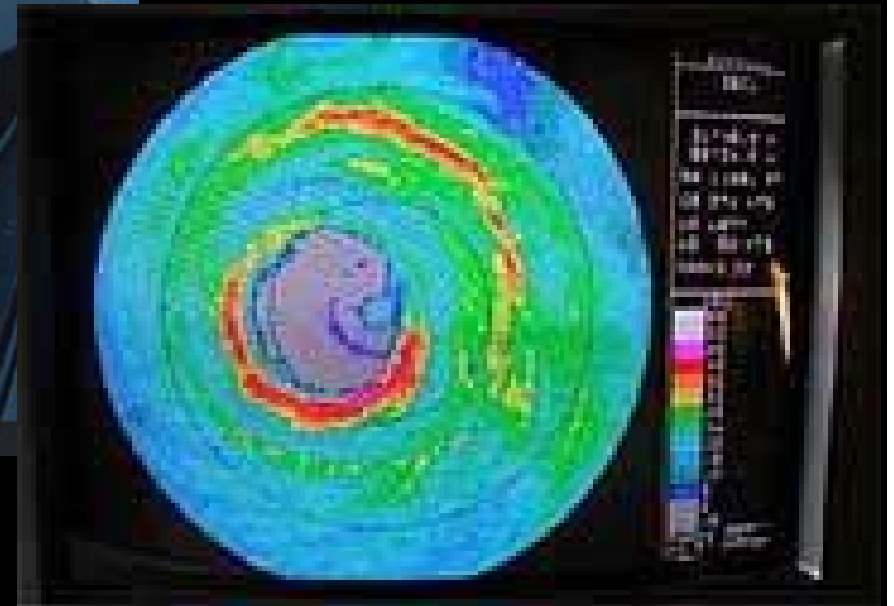
- Farnsworth Lantern (FALANT)
 - Designed to pass mild CVD in 1940's
- Known Problems:
 - administration, cheating, recording



Navy Future Requirements

- Computerized testing
- CVD Diagnosis Type and Degree
- Portable
- Shipboard & Forward Theater deployable
- Easy to use with minimal training
- Relative Low Cost
- Sensitive and Specific
- Print-out of results, PDF eDocument

Future of Multicolor Cockpit Displays



Current Advances in Color Testing

- Colour Assessment & Diagnosis (“CAD”) RGB, age correction, UK Civil Aviation Authority
- Cone Contrast Test (“CCT”) in use by USAF, RGB
- Waggoner Computerized Color Vision Test (“WCCVT”): optometry schools and offices, online testing for police, hospital, schools. Low Cost, easy to administer, RGB

WCCVT Software (ver1.0)

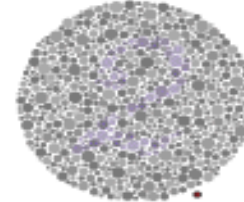
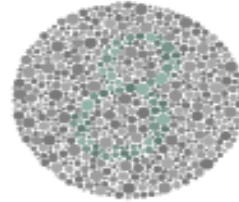
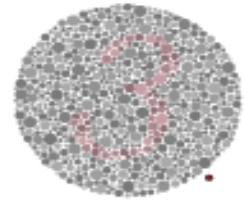
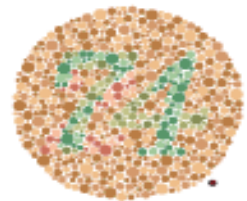
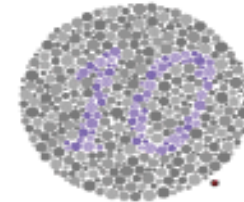
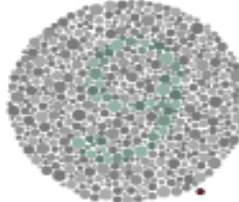
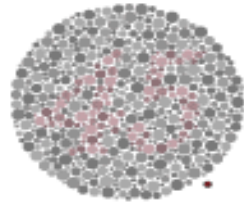
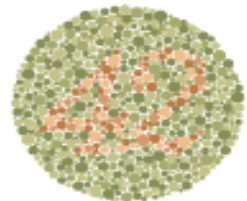
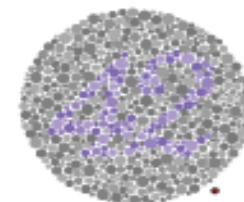
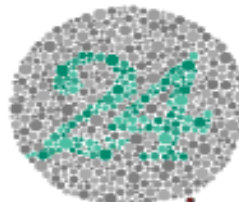
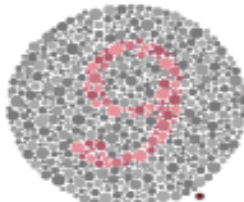
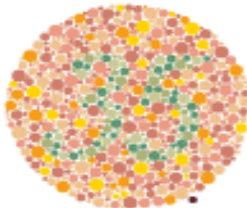
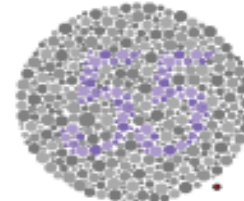
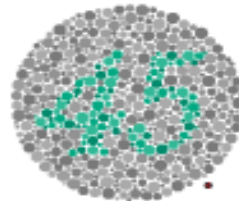
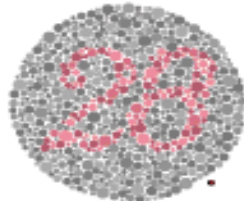
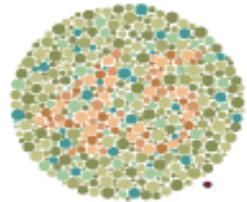
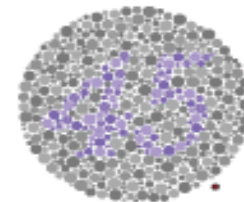
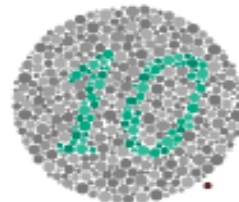
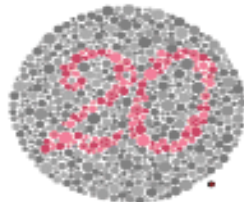
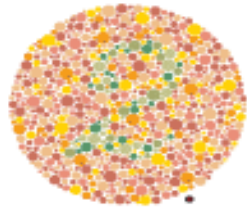
- Screener PIP Section (pass or fail)
- Individual Cone Sensitivity (Red, Green & Blue)
 - type and degree of CVD
- Computer Based (Windows - Apple)
- Colorimeter Calibrator (Spyder4)
- PDF and Print output
- Low Cost

PIP PLATES

PROTAN
RED WEAK

DEUTAN
GREEN WEAK

TRITAN
BLUE WEAK



Purpose

- ▣ Determine Sensitivity & Specificity of Waggoner Computerized Color Vision Test (WCCVT)
- ▣ Compare WCCVT to current tests
- ▣ Determine Sensitivity & Specificity:
 - PIP plate book
 - FALANT

Subject Population

- Age Range 18 -37 y.o.
- Average Age 23 y.o.
- Male 93%, Female 7%
- Subject Class:
 - Naval Aviator 45%
 - Aircrew 27%
 - Air Traffic Control 12%
 - Naval Flight Officer 7%
 - Medical Enlisted 5%
 - Flight Surgeon 4%

Data Collection

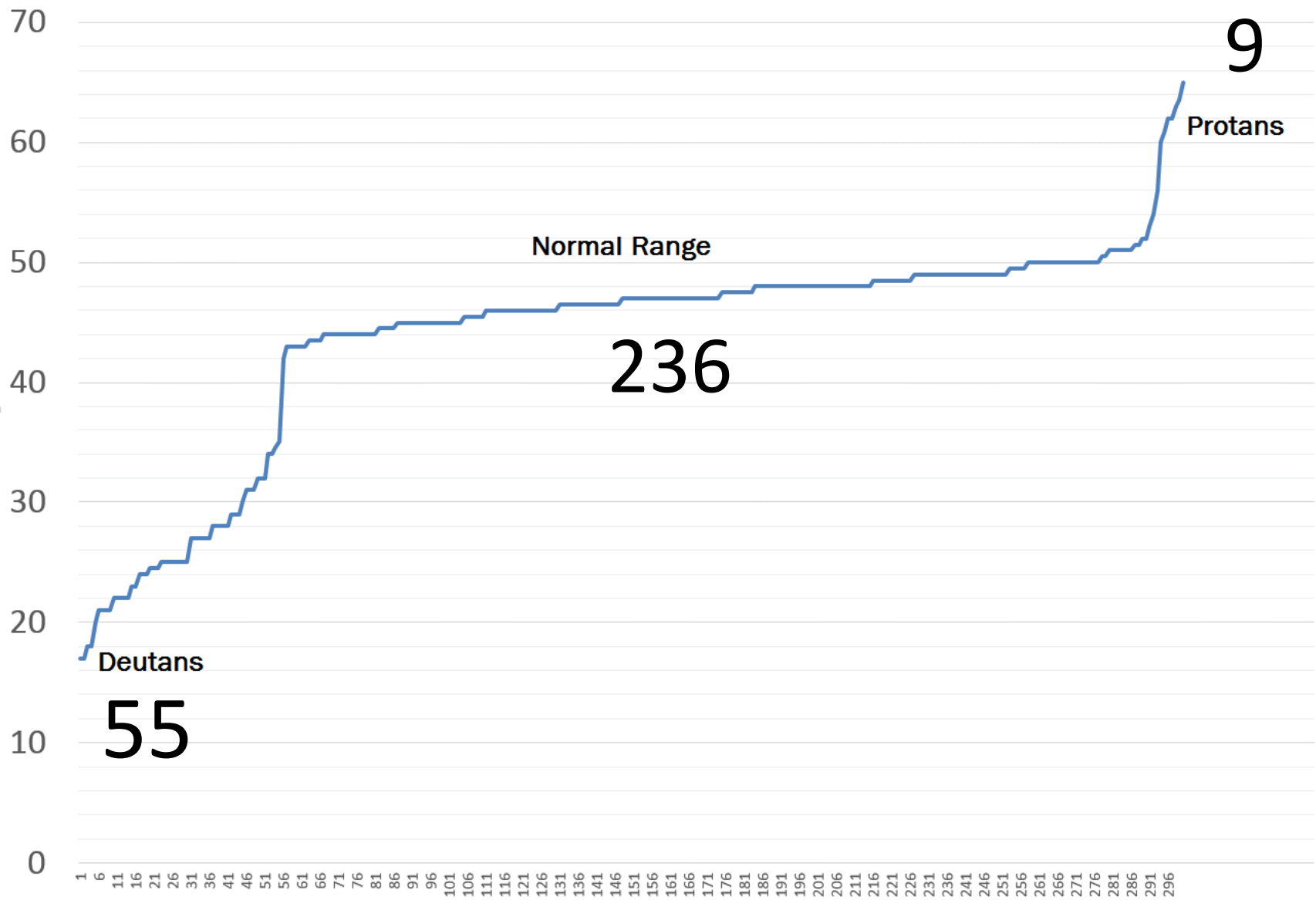
- Age, Gender, Job Field, Visual Acuity
- **Color Vision Tests**
 - Nagel Anomaloscope
 - FALANT (Optec 900)
 - 9/9 correct “Pass”, or 16/18 correct “pass”
 - Pseudoisochromatic Plates (PIPIC book)
 - 14 test plates, 12/14 correct “pass”
 - WCCVT
 - Four Sections: Screener, Red, Green, and Blue

WCCVT Scoring Method

- **PIP Screener:** 29 test plates: 'Pass' 26-29
- **Red & Green :** 32 test plates each
- **Blue :** 12 test plates

	<u>Correct</u>		<u>Correct</u>	
• <u>'Normal':</u>	R	G	28-32	B 10-12
• 'Mild':	R	G	15-27	B 6-9
• 'Moderate':	R	G	4-14	B 3-5
• 'Severe':	R	G	0-3	B 0-2

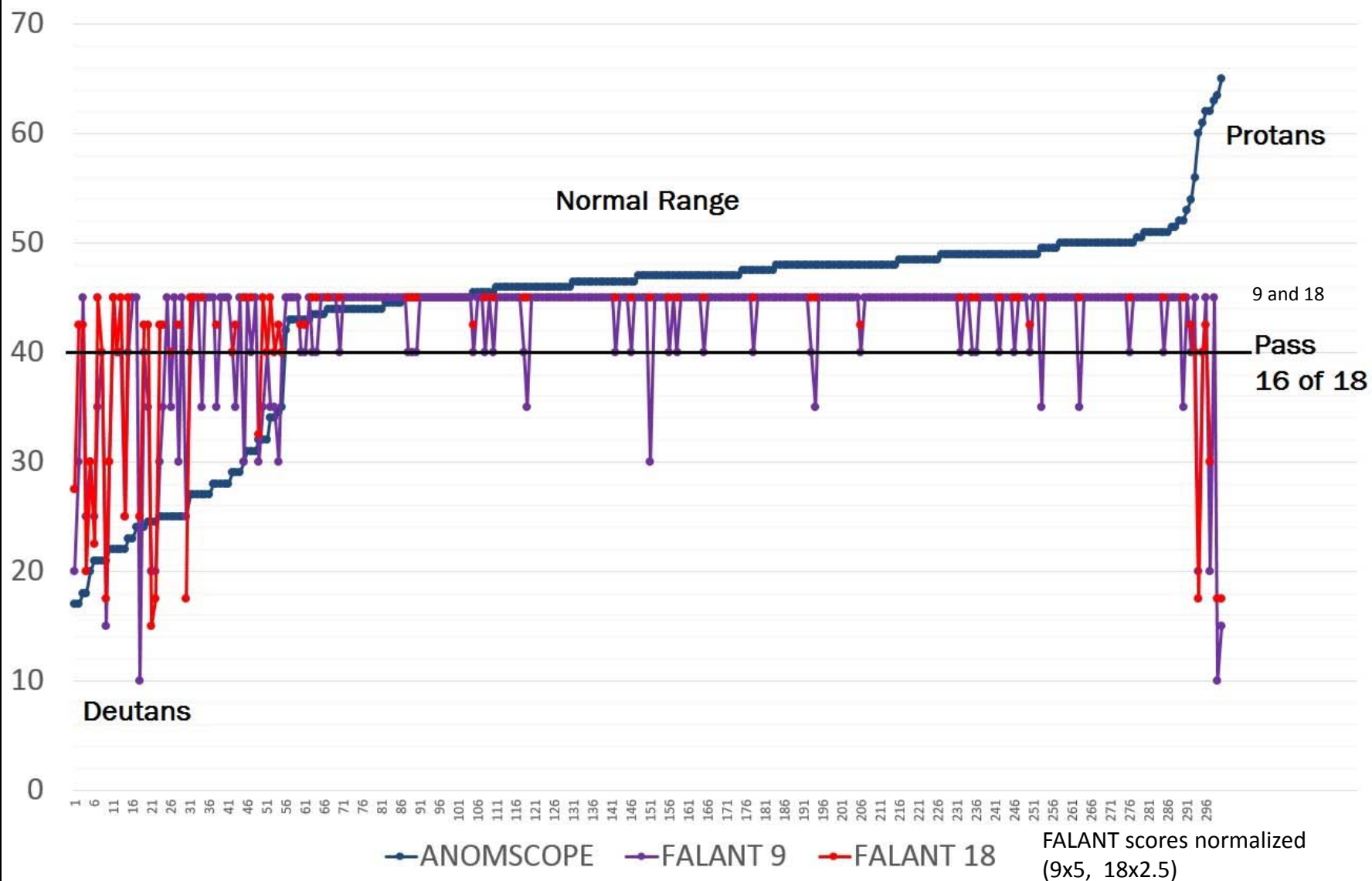
Anomaloscope Range



Results: FALANT

- FALANT Specificity 100%
 - For 16 correct of 18 presentations
- FALANT Sensitivity 25%
 - at score of 16 correct of 18
 - Confidence Interval: 15%-37%
 - Passed 80% of Mod Deutans
 - Passed 66% of Mod Protans

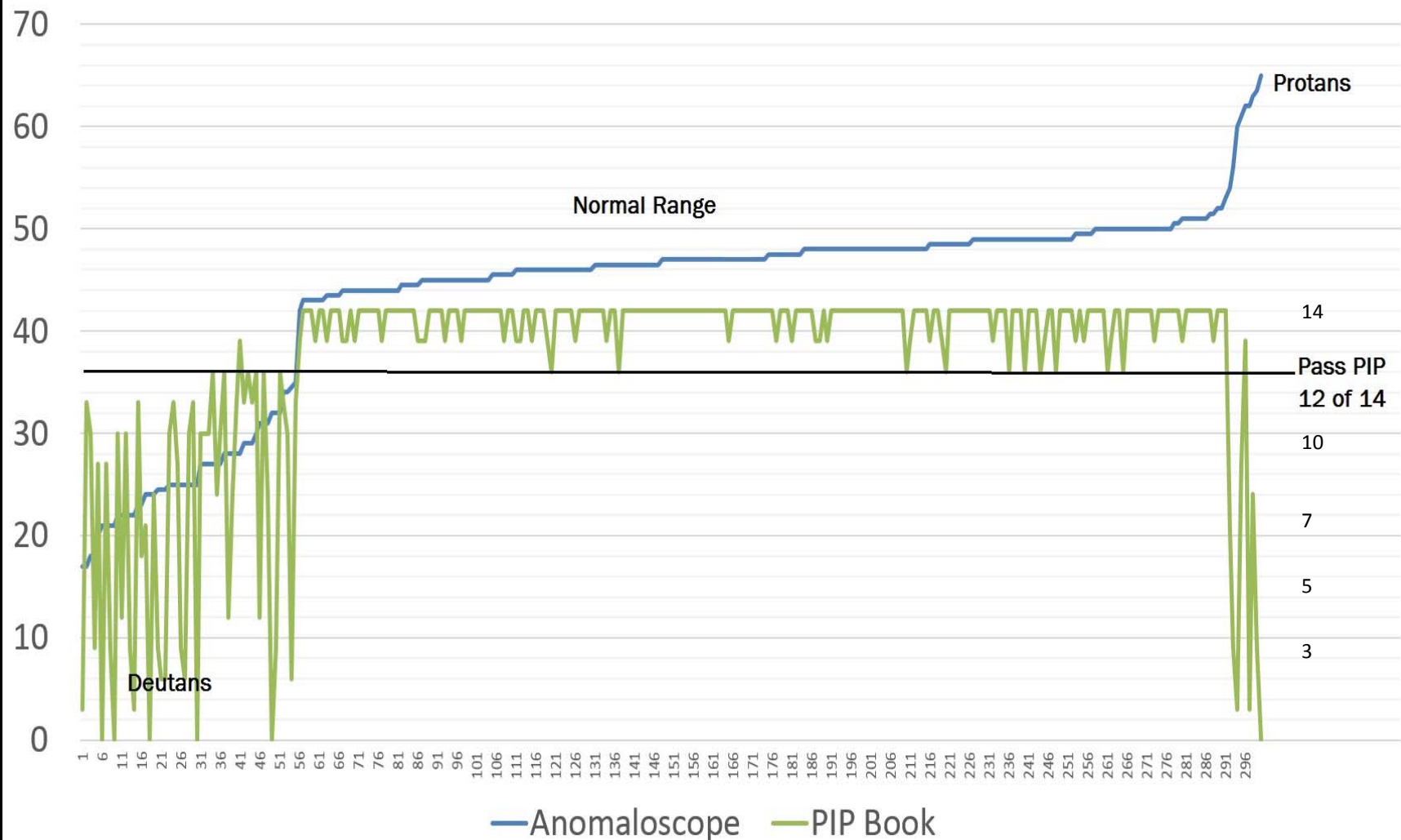
Anomaloscope vs. FALANT 9 and 18



Results: PIP

- PIP Book Specificity 100%
 - at score of 12 correct of 14 plates
- PIP Book Sensitivity 89%
 - at score of 12 correct of 14
 - Confidence Interval: 79% - 95%

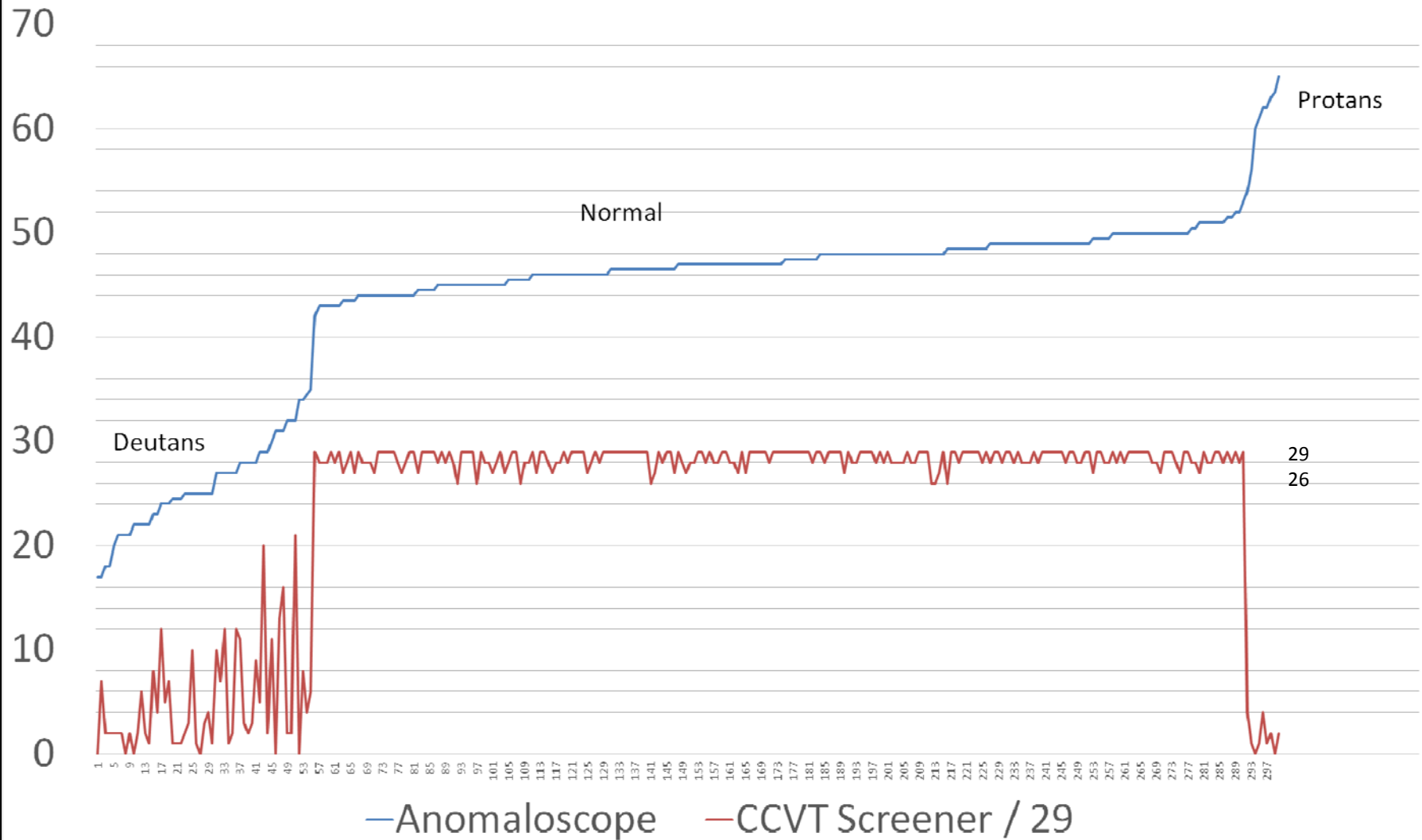
Anomaloscope vs. PIP Book



Results: WCCVT

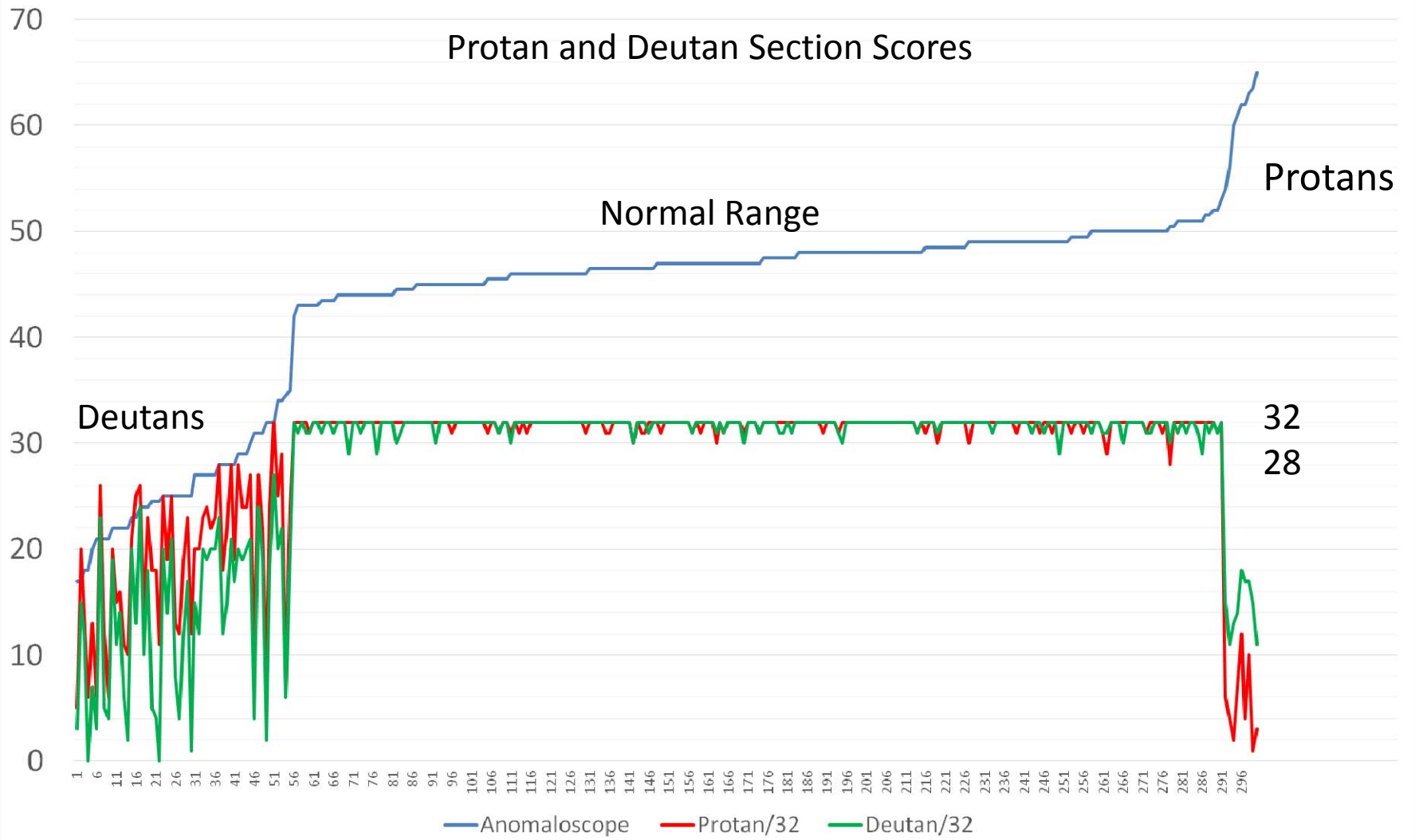
- 9 Protans (Nagel) == 9 Protans (WCCVT)
- 55 Deutans (Nagel) == 55 Deutans (WCCVT)
- No Tritans identified on WCCVT
- No mis-classifications by WCCVT
(Protan vs. Deutan)

WCCVT Screener vs. Anomaloscope



WCCVT vs. Anomaloscope

Protan and Deutan Section Scores

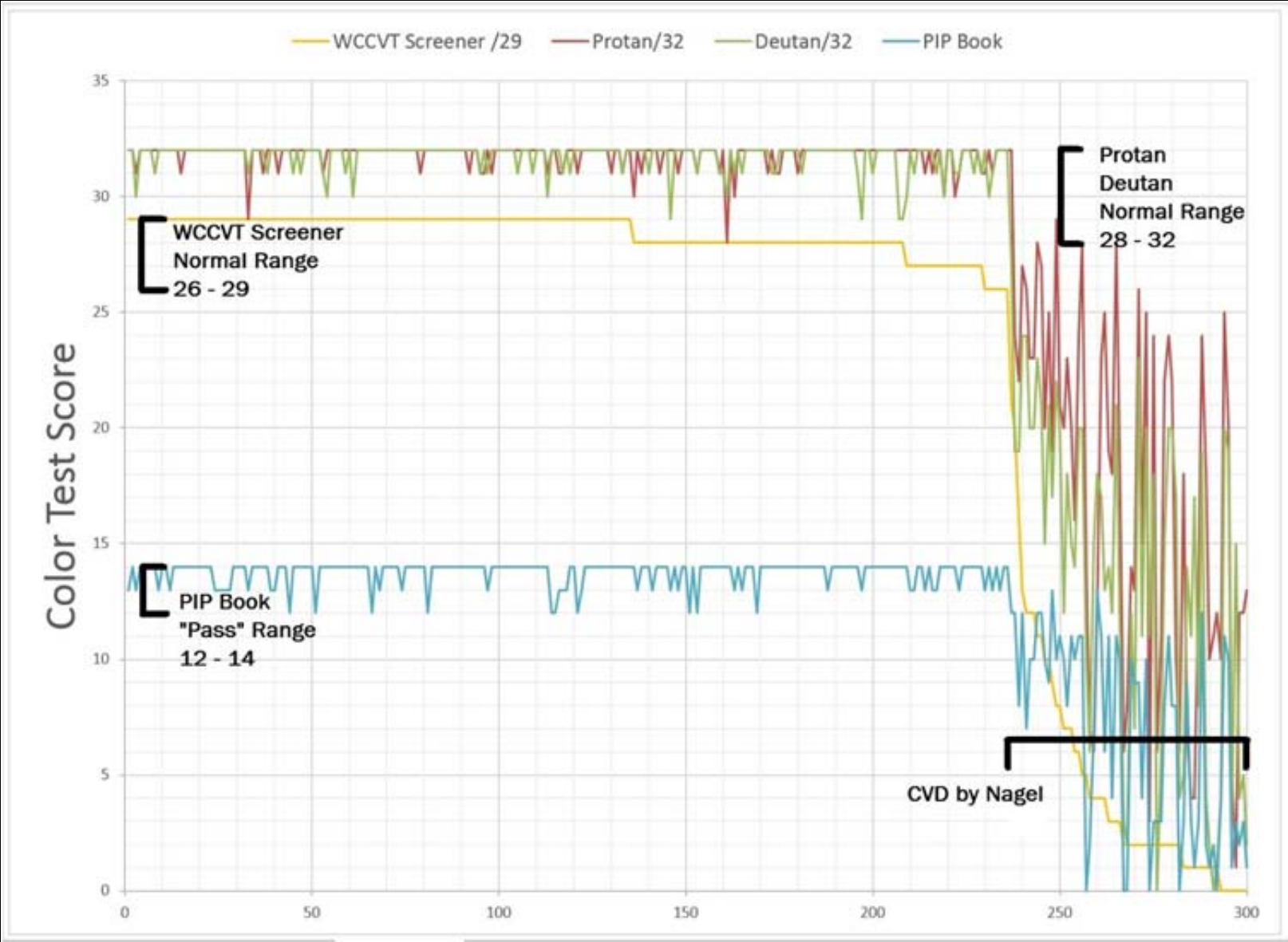


Results: WCCVT Screener and Cone Sections

- WCCVT 100% Specific
- 236 Normal (Nagel)
- 236 Normal (Screener section)
- 236 Normal (Protan and Deutan section)

- WCCVT 100% Sensitive
- 64 CVD (Nagel)
- 64 CVD (Screener section)
- 64 CVD (Protan or Deutan section)

WCCVT Screener



Discussion

- FALANT poor screening tool for detecting CVD
 - 25% Sensitivity
- FALANT passes majority of moderate CVD subjects
- PIP fair screener (89% sensitivity),
 - score 12 correct of 14
- **WCCVT 100% Specific and 100% Sensitive**
 - Excellent Objective Screening and Diagnostic Tool
 - Accurate Diagnosis of type and degree of CVD

Additional Findings and Discussion

- 1 in 4 Aviation Personnel with some CVD who previously screened “normal” on entrance exam: at NAMI “failed” PIP and FALANT when tested properly
 - Administration errors vs. memorization?
 - Similar rate found in USAF studies
- Need for computerized screening to reduce administration errors of PIP and FALANT.
 - training funds savings (est ~\$2.5M in 10 years; @ 1 failure prevented per wk)



Thanks to:
Konan-USA, CDR William Mann, CDR Merrill Rice,
LCDR Chris DeAngelis, CAPT Kris Belland

Future Navy Endeavors

- Validation Research Tablet Version of WCCVT
- Normalize CCT, CAD and WCCVT scores
- Rewrite **Aeromedical Waiver Guide** to reflect current color vision testing advancements and SODA Policy
- Continue to push to have **FALANT** removed from Navy MANMED physical standards policy
- Propose 'grandfather' current Aviators passing FALANT to allow continued flight on current platforms.
- Propose Navy policy to include **use of validated computer tests** for all color vision screening (Undersea, Surface, SPECOP)