

So You Want to be a Navy Pilot?

A Case Based Approach to Military Aviation Vision Standards

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“Medically Ready Force...Ready Medical Force”

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“Medically Ready Force...Ready Medical Force”

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Image courtesy of Lcdr Micah Kinney

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Image courtesy of LCDR Amanda Jimenez Myers

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Disclosures



- Dr. Micah Kinney and Dr. Amanda Jimenez Myers have no relevant financial or non-financial relationships to disclose relating to the content of this activity.
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Learning Objectives



At the conclusion of this activity, participants will be able to:

1. Explain the role of Vision in Aviation Performance and Safety of Flight.
2. Describe testing conditions and corrected visual acuity requirement for Student Naval Aviators.
3. Differentiate between binocular vision requirements for pilots and other aviation candidates.
4. Recognize Color Vision Standards for Naval Aviation.

Navy Aerospace Optometry (AsO): Background

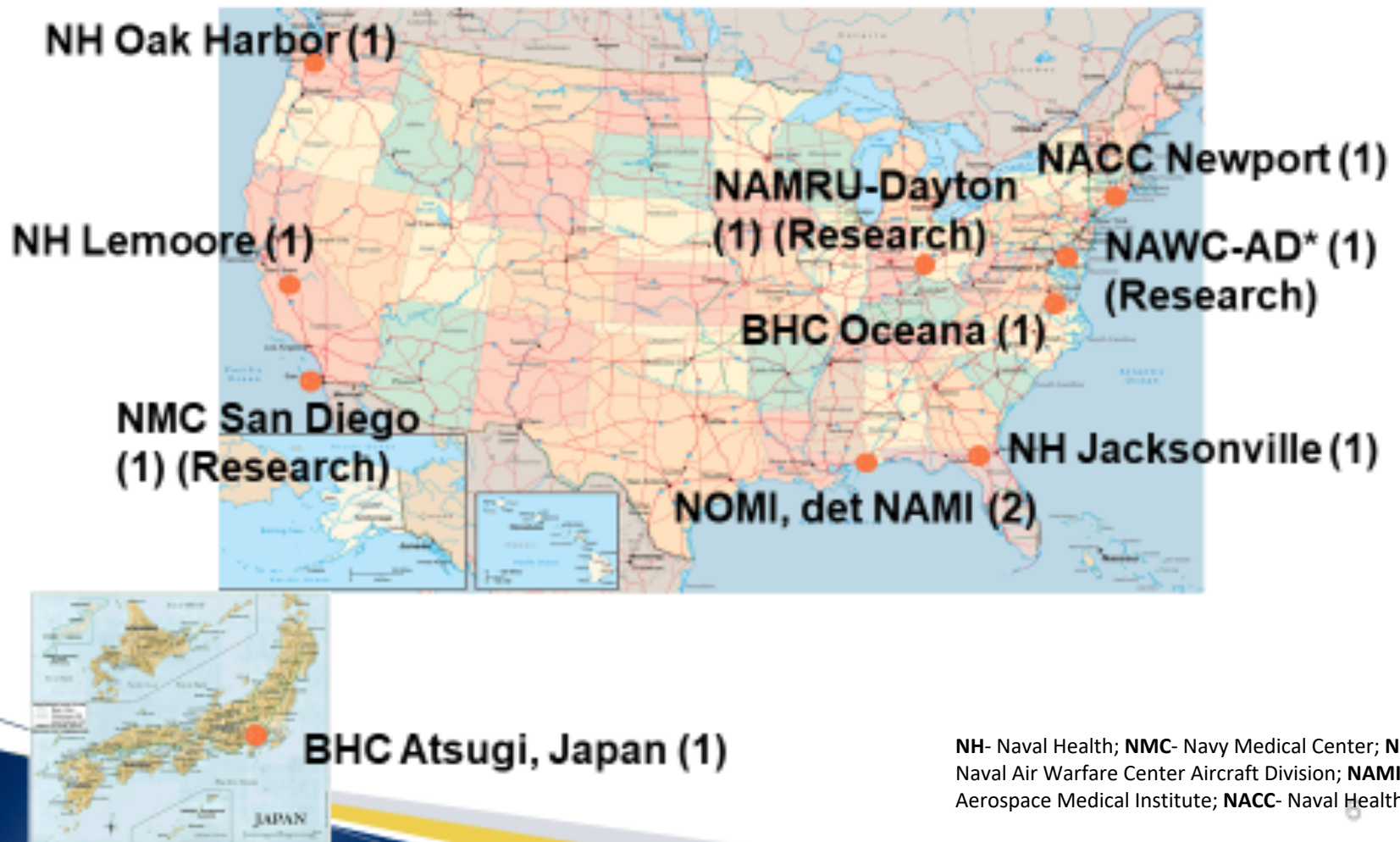


- First AsO 1992: Rear Admiral (ret) Michael Mittleman
 - Currently: 34 trained AsO
 - AsOs around the Globe
 - Major Naval Air Bases around including Japan
 - Naval Aeromedical Institute
 - Naval Air Forces
 - Navy Medical Research Unit-Dayton (NAMRU-D)
 - National Aeronautics and Space Administration (NASA)
- Instruction at Naval Aerospace Medical Institute (NAMI)
 - Flight Surgeons, Optometrists, Physiologists, Experimental Psychologists, Physician Assistants, Partner Nation Medical Officers



Image courtesy of LCDR Micah Kinney

U.S. Navy Aerospace Optometry



NH- Naval Health; NMC- Navy Medical Center; NAWC-AD- Naval Air Warfare Center Aircraft Division; NAMI- Naval Aerospace Medical Institute; NACC- Naval Health Care

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Navy Aerospace Optometry (AsO): Background



- Ground school and flight in T-6 Texan and TH-57 Ranger
- Provide expertise on vision standards, visual performance and ocular safety in the aerospace environment
 - Laser Vision Safety
 - Mission Essential Contact Lens
 - Refractive Surgery Consultation
 - Expert in complicated waiver cases with expedited return to flight



Images courtesy of LCDR Micah Kinney

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Polling Question 1



What percentage of people in this lecture interact with active fliers on a daily basis?

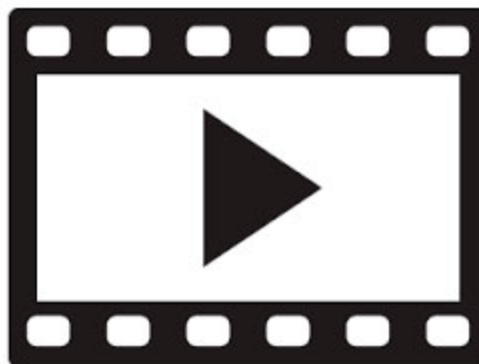
- ☐ Never
- ☐ Somewhat
- ☐ Everyday

Visual Challenges During Flight



- Fast Paced Environment
- Multiple sources of critical information
 - Instruments, Out of cockpit scene, auditory information
- Weather
 - Fewer or deteriorated visual cues
- Night flying
 - Goggles
- Carrier Landings
- Visual Illusions

Standby for Video



Application of Standards



- Manual of the Medical Department (MANMED)
CHAPTER 15
- NAMI Aeromedical Reference and Waiver Guide
 - <https://www.med.navy.mil/sites/nmotc/nami/arwg/Pages/AeromedicalReferenceandWaiverGuide.aspx>
- USN, United States Air Force (USAF), USA Aviation Standards
- Federal Aviation Administration (FAA) Standards

Polling Question 2



What is the estimated cost to train a fully proficient tactical aviator?

- ☐ \$1M
- ☐ \$2M
- ☐ \$5M
- ☐ \$11M

Review of Department of Defense (DoD) and Federal Agencies Vision Standards



2020 - FEDERAL SERVICES COMPARATIVE AVIATION VISION STANDARDS

			Each Eye		Refractive Error (any meridian)						Each Eye		Phoria		Stereopsis		Color Visio		Refractive Surgery		Intraocular Pressure									
			Unaided Distant VA	Corrected Distance VA	Myopia	Hyperopia	Cyl	Aniso			NPC (mm)	Near VA	ESO	EXO	Hyp er	Tropia	Test	Score	Test / Score	RK	PRK/ LASEK	LASIK/ SMILE	IOP in mmHg							
USAF	Flying Class	Category	No Standard	20/20	-3.00	+2.00	-1.50	2.00	No Std.	C 20/20	10	6	1.5	0	Optec2300: 40 sec or A-B	CCT 55+	N	Allowed, No waivers required for uncomplicated cases if pre-op refractive error ≤ +3.00, ≤ -8.00 and ≤ 3.00 D of astigmatism. SMILE not approved for aircrew.	≤ 21 mmHg or ≤ 3 mmHg difference. (DQ only for applicants). If applicant has IOP >21, but <27 and pachs >540, considered to meet std.											
	IA (CSO A)	-4.50			+3.00	-2.00	2.50																							
	II (P)	N/A			N/A	N/A	N/A																							
	II (FS/CSO)	N/A			N/A	N/A	N/A																							
	III Untrained *	-5.50			+5.50	-3.00	3.50																							
	III Trained *	No standards																												
	RPA Pilot (Untrained)**	-4.00			+3.50	-2.00	2.50																							
	RPA Pilot (trained)	No standards																												
USA	I (W/C-OF)	20/50	20/20-1	-1.50	3.00	-1.00	No	100	20/20	8	8	1	0	AFVT: 40 sec Randot: 40 sec Titmus: 40 sec	PIP/12/14 "mild" 55+ computer	N	No waiver req Pre Sx: +4 to -6 SE, ≤3 Cyl; Waiver if	IOP = 8-21 ≤ 3 mmHg diff.												
	II (Pilot)	20/400		No Standard (Designated)				UC=20/400 C=20/20																						
	III (Flight Surgeon)	20/400		No Standard (Designated)				UC=20/400 C=20/20																						
USN	I SNA (P)	20/40-0	20/20-0	Cyclo - Sph		-1.50	+3.00	-1.00	3.50	No Standard	UC=20/40 C=20/20	6	6	1.5	0	VTA-ND: 25sec Optec2300: A-D PASS Verhoeff: 8/8 Randot:40sec Titmus: (40sec)	PIP or Computer 12/14 PIP, "mild" WCCVT / 55+ CCT	No waiver req for App. Pre Sx: +3.00 to -8.00 SE, ≤3.00 Cyl. Design. Pre Sx: No waiver req for App. Pre Sx: +6.00 to -8.00 SE, ≤6.00 Cyl. Designated: No limit (done at)	IOP ≤22, ≤4 mmHg difference											
	I SG1	20/100	20/20-0**	No Standard (Designated Status)				UC>20/40 = Must fly with Rx C=20/20																						
	I SG2	20/200	20/20-0**	No Standard (Designated Status)				UC=20/100 C=20/20																						
	I SG3	20/400	20/20-0**	No Standard (Designated Status)				C=20/20																						
	IV (UAS/UAV)	No Standard	20/20-3***	No Standard				NOTOSP (NOHOSH) *																						
	II SNFO	No Standard	20/20-3***	No Standard				No Standard Same as Class I																						
	II NFO, AMO, AC (Fixed Wing only)	No Standard	20/20-3***	No Standard				No Standard																						
	II Air Crew (Rotary Wings)	20/100	20/20-3***	No Standard				No Standard																						
Coast Guard	Initial Class 1 (P)	20/50	20/20-1	Note: also for Cyclo Refraction				No Standard	100	UC 20/20- 1	8	8	1	Ref. to Opto. any movement on Cover- Uncover or	40 Sec of Arc @ 20 feet AFVT/OPTEC 2300: A-B Titmus II Line 1-9 Randot circles Lines 1-7	PIP or Computer	12/14 PIP "mild" WCCVT / 55+ CCT	No waivers granted.	Allowed. For candidates, Pre-operative refractive limits: Sphere -8.00 to +6.00, Cylinder -3.00 to +3.00, Anisometropia: 3.5 diopters. (Beyond these standards, a waiver requires	IOP from 8-21, ≤3 mmHg difference										
	Comprehensive Class 1 (P)	20/200		-1.50	+3.00	-1.00																								
	Initial Class 2	20/400																												
	ATC (Initial C 3)	20/100																												
	Air Crew (Initial C 3)	20/100																												
	Air Crew (Comp. C 3)	20/200																												
	Landing signal Officer-C 3	20/200																												
FAA	ATC (Comp. C 3)	20/200	No Standard	20/20	Not Required				No Standard	100	Near VA: C=20/40 at 16" Intermed. VA: C=20/40 at 32" if over 50	6	6	1	No Hx of diplopia	No Standard	PIP	9 of 15	Allowed ed. Within 2 years of surgery requires exam by optometrist stating no complications. After 2 years, just meets visual acuity	No Standard										
	1st Class Airline Transport	No Standard			20/20	No standard															Near VA: C=20/40	No standard				No Standard				
	2nd Class Commercial	No Standard			20/40	No standard															Near VA: C=20/40	No standard				No Standard				
	3rd Class Private	No Standard	20/40	No standard				Near VA: C=20/40	No standard				No Standard																	

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Definitions



- Applicants: Student status until Winging
 - Class 1: Student Naval Aviator (SNA)
 - Class 2: Student Naval Aeromedical Flight Officer (SNFO), Student Aeromedical Officer, Student Naval Aircrew
 - Class 3: Student Air Traffic Control
 - Class 4: Unmanned Aerial Systems
- Designated: Winged Aviator
- Position
 - Physically Qualified
 - Not Physically qualified
- Conditions
 - Not Considered Disqualifying (NCD)
 - Considered Disqualifying (CD)

Can a Waiver be given?

Polling Question 3

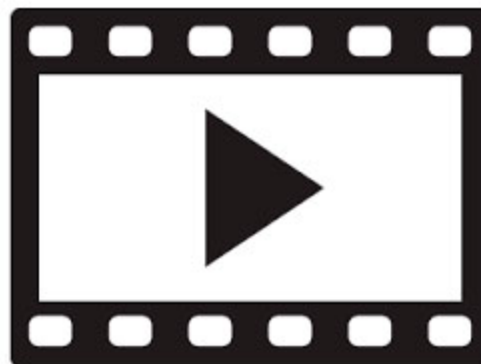


Soft Contact Lenses are authorized for flight.

☐ True

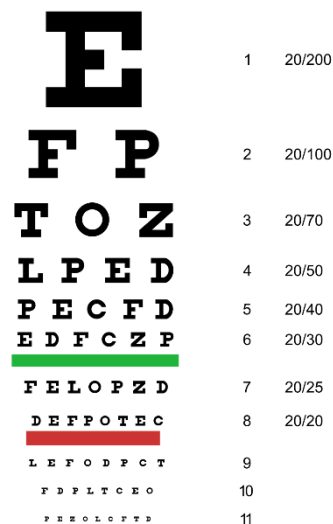
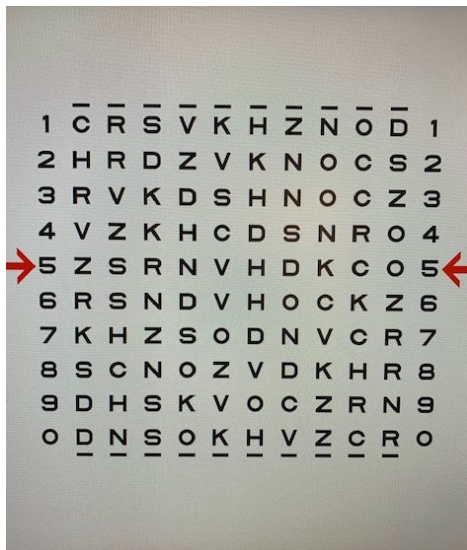
☐ False

Standby for Video



Visual Acuity Standards

- How to test: GOODLITE vs. Snellen
- Differ by Class and between Applicants and Designated
- SNA Corrected and Uncorrected Standards
- Flying with Glasses and “Cheaters”



Refractive Error Standards



- SNAs:
 - Uncorrected Standards: 20/40-0 OD/OS (GL)
 - +3.00 D to -1.50 D of power in any meridian
 - No more than 1.00 D of astigmatism (cylinder)
 - Must correct to 20/20-0 OD/OS
 - Cycloplegic exam with 1% cyclopentolate
 - Hyperopia greater than +3.00 is Considered Disqualifying for flight for Student Naval Aviators

D- Diopter; OD- Oculus Dextrus; OS- Oculus Sinister

Corneal Refractive Surgery and Flight



- Refractive Surgery (PRK/LASIK/SmILE)
 - Applicant SNA Applicant: No waiver required for pre-op within +3.00 to -8.00 SE and ≤ 3.00 cyl
 - Applicant Class 2-4: No waiver required if pre-op within +6.00 to -8.00 SE and ≤ 6.00 cyl
 - Designated LASIK/SmILE: No waiver required for pre-op within -11.50 to +6.00 SE and ≤ 6.00 D cyl
 - Designated PRK: No Limit for pre-op

****Implantable Collamer Lenses (ICL) Considered Disqualifying for Class 1****

PRK- Photorefractive keratectomy; **LASIK**- Laser in-situ keratomileusis; **SmILE**- Small incision lenticule extraction; **SE**- Spherical Equivalent; **cyl**- cylinder

Latent Hyperopia Case



- SNA Applicant
 - No H/O glasses wear. Visual acuity (VA) without specs OD: 20/20 OS 20/25
 - Manifest Refraction and VA (GL)
 - OD+1.25 sph 20/20-0
 - OS +2.50-0.50x075 20/20-0
 - Cycloplegic Refraction
 - OD +2.25 sph
 - OS +4.00-0.50x075
 - Standard +3.00 to -1.50 in any meridian, no more than 1.00 D Cyl
 - Considered Disqualifying for SNA, Waiver not Recommended
 - Not Considered Disqualifying for SNFO

Lens Opacity



- Standard:
 - Cataracts are considered disqualifying for flight, but waiverable if vision is correctable to 20/20 requirement.
 - Once vision has deteriorated to less than 20/20 correctable OR the patient has positive glare test, the aviator should be grounded until successful surgical removal of the cataract.
 - Glare Testing

Polling Question 4



Causes of decreased depth perception include abnormal muscle alignment and decreased vision in one or both eyes.

☐ True

☐ False

Case: Cataract

- Designated Class 1 Naval Aviator
- VA with glasses: OD 20/20 OS 20/20
- Anterior Segment Exam Within Normal Limits (WNL) except
Lens: 2+Posterior Subcapsular Cataract OD/OS



- Glare Testing:
 - VA 20/20 OD/OS

Polling Question 5



A person with a Moderate Color Vision Deficiency is considered Safe for flight.

☐ True

☐ False

Current Research in Visual Acuity



- Bangerter Foils to artificially reduce vision in one eye
 - Reliable reduction to 20/44 in one eye
- No performance difference in landing flight simulator
- Slower identification of traffic
- No significant effect on binocularity

Binocular Vision and Stereopsis



- Standards Binocular Vision:
 - Phoria Limits for Naval Aviators (waivers not typically considered) and Unmanned Air Vehicles (UAV) (waivers considered)
 - 6 horizontal phoria, 1.5 vertical phoria
 - Excessive phorias: can lead to defective stereopsis or diplopia especially when fatigued
 - Strabismus or H/O strabismus: CD
 - NOTOSP: No obvious TROPIA or symptomatic PHORIA
- Standard Stereopsis (Depth Perception):
 - Depth Perception of 40 seconds of arc is required for Naval Aviators and Aircrew- Rotary Wing

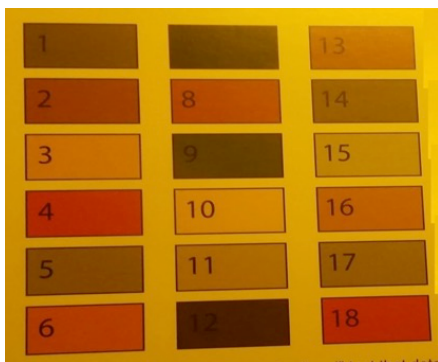
Case: Binocular Vision

- 21 y/o SNA Applicant
- Corpsman Testing: Within standards VA, Phoria, Depth, but movement on Cover Test
- Provider Testing:
 - Cover Test: 18 PD R EsoTropia
 - Depth Perception 50 seconds
 - VA 20/20- OD, OS
 - Additional BV Tests by Provider:
 - Worth Four Dot: 5 Dots
 - Red Lens Testing: Diplopia in all gazes
 - History: Diplopia when tired or with prolonged reading



Why is Color Vision Important

- Required to accurately identify warning lights and color visual displays
- Airfield and shipboard lighting, colored smoke in combat, ground target identification, aircraft formation lights, etc.
- Laser eye protection glasses and protective visors may worsen color vision problems



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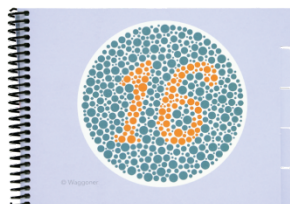
Color Vision



- Standards:
 - Farnsworth Lantern (FALANT) designed in 1947s
 - Accepted by Sub Community and Aviation community soon after
 - No longer acceptable for Aviation Applicants after 01 JAN 2017
 - Passed Color Safe, not color Normal
- Approved Navy Color Vision Tests:
 - Pseudo Isochromatic Plates (PIP): 12/14 Pass
 - Computerized Color Vision Test: Mild or Normal
 - Waggoner Computerized Color Vision Test (CCVT)
 - Rabin Cone Contrast Test (monocular)
 - Universally accepted by all services
 - Color Assessment and Diagnosis (CAD)
 - Validated during study, used mostly for research

Different types of color vision tests

1. Pseudoisochromatic Plate Tests (PIP)
2. Computerized Color Vision Test
3. Lantern Color Vision Tests



PIP 24 Plate Edition



Ishihara



Appropriate Lighting



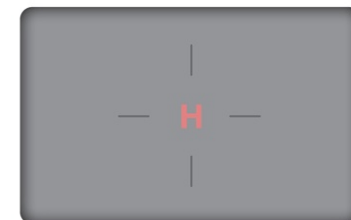
Optec 900



Farnsworth Lantern



Waggoner CCVT



Rabin Cone Contrast

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Practical Performance Testing in Color Vision



- UH-1 Huey Pilot
- Initial flight physical failed PIP, but passed FALANT with 16/18
- Next flight physical failed PIP and FALANT
- Waggoner CCVT revealed moderate Protan deficiency
- Grounded until practical performance testing
 - Naval Air Training and Operating Procedures Standardization (NATOPS) Officer, Safety Officer, Flight Surgeon
- Results
 - Compared to students in same location in syllabus

Results



- 5 colors - various colors of smoke:
 - Subject: 60% accurate
 - Controls: 100% accurate



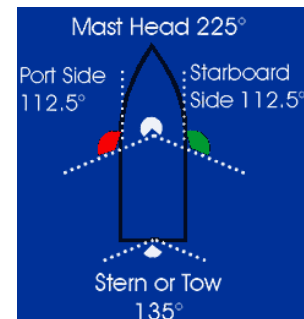
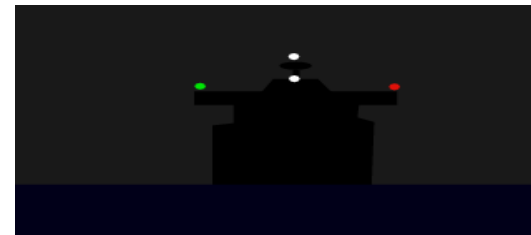
- 8 items - various runway lights:
 - Subject: 88% accurate
 - Controls: 100% accurate



- 3 items - aircraft lighting:
 - Subject: 33% accurate
 - Controls: 100% accurate









- 18 items - simulated boat environment:
 - Subject: 58% accurate
 - Controls: 100% accurate



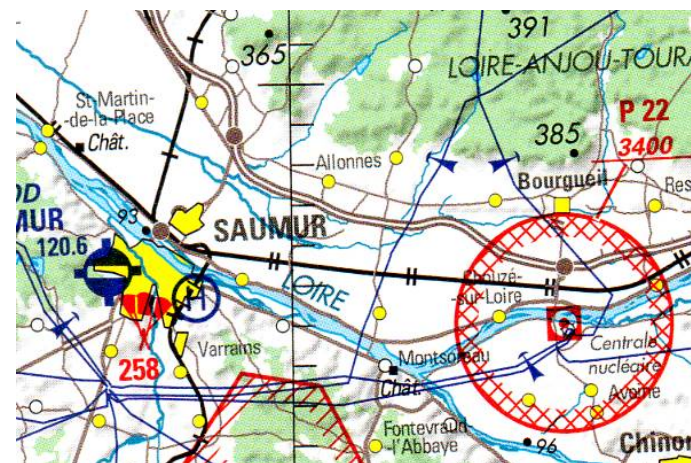
Results cont.

- 6 items - ALDIS Lamp signals:
 - Subject: 33% accurate
 - Controls: 100% accurate



ATC Light Signals		
GROUND	SIGNAL	AIR
Cleared for Takeoff		Cleared to Land
Cleared to Taxi		Return for Landing
STOP		Give Way Continue Circling
Taxi Clear of Runway		Airport Unsafe DO NOT LAND
Return to Starting Point on Airport		Not Applicable
Exercise EXTREME CAUTION		Exercise EXTREME CAUTION

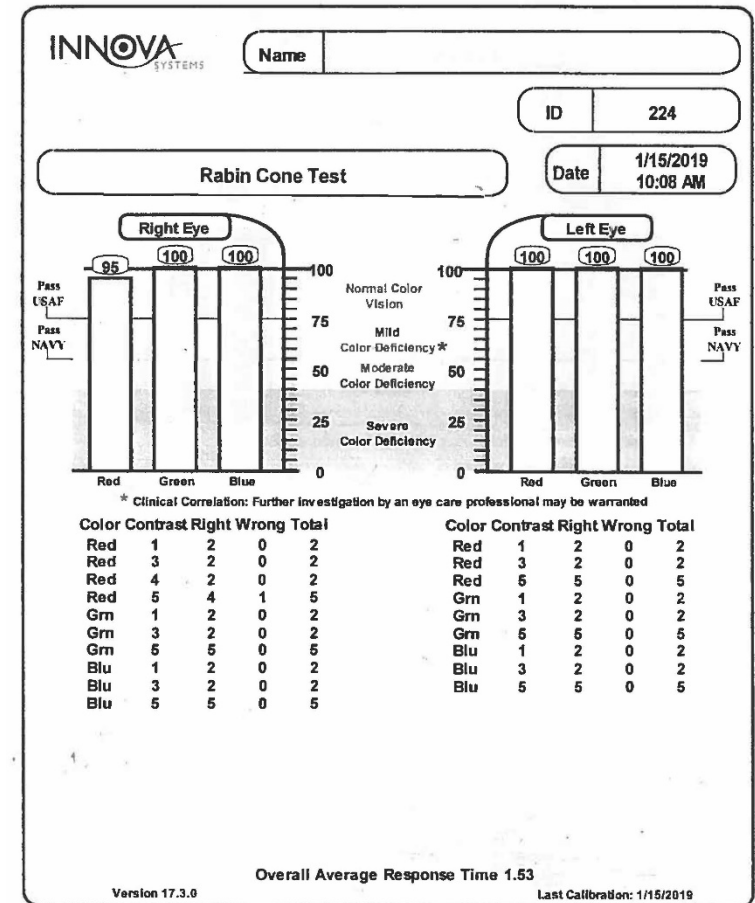
- 17 items - map colors and markings:
 - Subject: 82% accurate
 - Controls: 100% accurate



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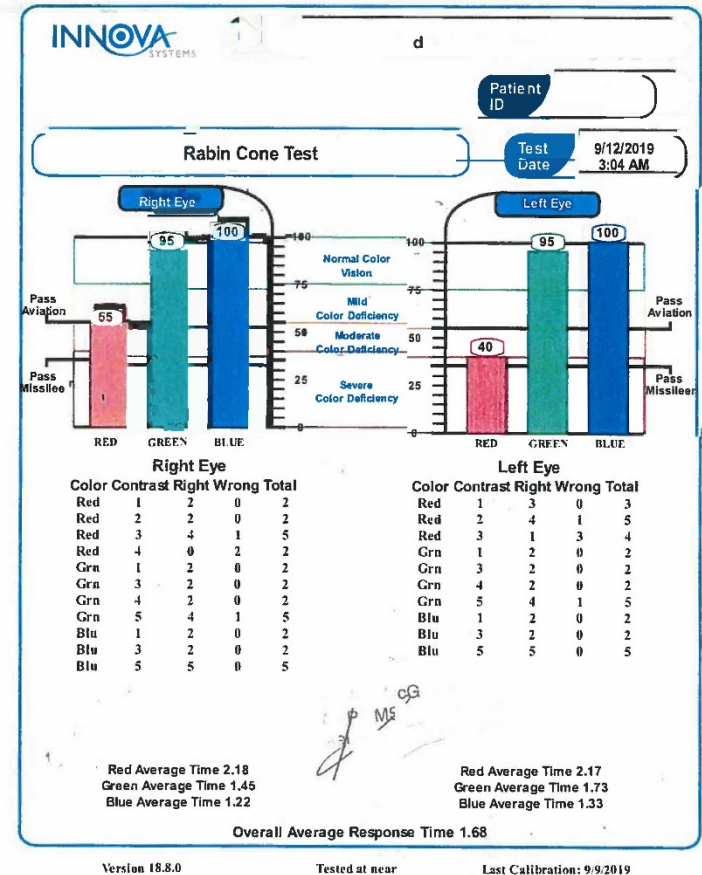
Case: Color Vision

- United States Coast Guard (USCG) SNA Applicant
 - Rabin Cone Contrast Testing done in town with no color deficiency noted



Case: Color Vision

- Rabin Cone Contrast Testing performed at NAMI with MODERATE Protan Deficiency OD and Severe Protan Deficiency OS
- How did he get two distinctly different results?



Key Takeaways



- Navy vision standards play a critical role in Safety of Flight and Performance in the Aircraft.
- Visual Acuity for Student Naval Aviators is tested on the Goodlight Chart with best corrected Visual Acuity 20/20-0 OD/OS. At this time, if VA is not 20/20-0, the condition is considered disqualifying, waiver not recommended.
- Binocular Vision requirements for Naval Aviators include phoria testing within 6 diopters of horizontal and 1.5 diopters of vertical prism, and no strabismus or history of strabismus surgery. Excessive reading or fatigue can lead to symptoms of diplopia with any of the above listed conditions.
- Color Vision standards for all classes of Naval Aviation allow for COLOR SAFE individuals, not just color normal. While FALANT is not longer an acceptable test, normal and mild deficiencies on computer color vision tests are acceptable for flight.

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To receive CE/CME credit, you must register by 0745 ET on 24 July 2020 to qualify for the receipt of CE/CME credit or certificate of attendance. You must complete the program posttest and evaluation before collecting your certificate. The posttest and evaluation will be available through 6 August 2020 at 2359 ET. Please complete the following steps to obtain CE/CME credit:

1. Go to URL: <https://www.dhaj7-cepo.com/content/clinical-communities-speaker-series-health-innovations-and-promising-practices-jul-2020>
2. Click on the REGISTER/TAKE COURSE tab.
 - a. If you have previously used the CEPO CMS, click login.
 - b. If you have not previously used the CEPO CMS click register to create a new account.
3. Follow the onscreen prompts to complete the post-activity assessments:
 - a. Read the Accreditation Statement
 - b. Complete the Evaluation
 - c. Take the Posttest
4. After completing the posttest at 80% or above, your certificate will be available for print or download.
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