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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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.
Navy Aerospace Optometry (AsO): Background

- First AsO 1992: Rear Admiral (ret) Michael Mittleman
  - Currently: 34 trained AsO
  - AsO 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
U.S. Navy Aerospace Optometry

NH Oak Harbor (1)

NH Lemoore (1)

NMC San Diego (1) (Research)

BHC Oceana (1)

NOMI, det NAMI (2)

NACC Newport (1)

NAMRU-Dayton (1) (Research)

NAWC-AD* (1) (Research)

NH Jacksonville (1)

BHC Atsugi, Japan (1)

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

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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
Application of Standards

- Manual of the Medical Department (MANMED) CHAPTER 15
- NAMI Aeromedical Reference and Waiver Guide
- 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
### 2020 - FEDERAL SERVICES COMPARATIVE AVIATION VISION STANDARDS

<table>
<thead>
<tr>
<th>Flying Class</th>
<th>Category</th>
<th>Unaided Distance VA</th>
<th>Refractive Error (any meridian)</th>
<th>Near VA</th>
<th>Phoria</th>
<th>Stereopsis</th>
<th>Color Visio</th>
<th>Refractive Surgery</th>
<th>Intraocular Pressure</th>
</tr>
</thead>
</table>
| USCG         | 3rd Class Private | ATC (C 3) | C=20/40 at 16” | UC=20/40 | 6 | No Standard | No Standard | No waivers required for uncomplicated cases | ≤ 21 mmHg or ≤ 3 mmHg difference.
| USAF         | 2nd Class Airline Transport | No Standard | UC=20/40 | 6 | No Standard | No Standard | No Standard | No Standard | ≤ 21 mmHg or ≤ 3 mmHg difference.
| USAF         | 3rd Class Private | No Standard | UC=20/40 | 6 | No Standard | No Standard | No Standard | No Standard | ≤ 21 mmHg or ≤ 3 mmHg difference.

**Coast Guard**

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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?

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Polling Question 3

Soft Contact Lenses are authorized for flight.

- True
- False
Standby for Video

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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

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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**

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

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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

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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

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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

Images courtesy of NAMI

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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

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Results cont.

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

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

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<table>
<thead>
<tr>
<th>ATC Light Signals</th>
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<tr>
<td><strong>GROUND</strong></td>
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<tr>
<td>Cleared for Takeoff</td>
</tr>
<tr>
<td>Cleared to Taxi</td>
</tr>
<tr>
<td>STOP</td>
</tr>
<tr>
<td>Taxi Clear of Runway</td>
</tr>
<tr>
<td>Return to Starting</td>
</tr>
<tr>
<td>Point on Airport</td>
</tr>
<tr>
<td>Exercise EXTREME</td>
</tr>
<tr>
<td>CAUTION</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
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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?

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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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References


http://www.operationalmedicine.org/Library/Manuals/ManMed15/SectionTop.html


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