Evaluation of optometrists' understanding of the visual needs and expectations of pilots

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Abstract
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Discussion: Optometrists can better serve their pilot patients by becoming aware of vision care issues that are of interest to pilots. Also, familiarity with the Federal Aviation Regulations (FAR, Part 67) would facilitate communication between optometrists and pilots. However, the responsibility for meeting the needs and expectations of the pilot does not lie entirely with the optometrist. The percentage of pilots within an optometrist's patient base may be less than one percent. Therefore, a significant responsibility lies with the pilot to educate his or her optometrist.

Degree Type
Thesis

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EVALUATION OF OPTOMETRISTS' UNDERSTANDING OF THE VISUAL NEEDS AND EXPECTATIONS OF PILOTS

By

TRACEY L. JANETSKY
LISA A. WALSH

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
for the degree of
Doctor of Optometry
May, 1995

Advisor:
Robert L. Yolton, Ph.D., O.D.
EVALUATION OF OPTOMETRISTS’ UNDERSTANDING OF THE VISUAL NEEDS AND EXPECTATIONS OF PILOTS

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About the Authors

Tracey L. Janetsky will receive her Doctor of Optometry degree from Pacific University in May, 1996. She has a B.A. in Art from the State University of New York at Albany and has also attended Marist College and Ohio State University. While attending Pacific University, she illustrated an ocular anatomy textbook to be published in the summer of 1995. Tracey is married to a professional helicopter pilot, and plans to practice optometry in the Pacific Northwest.

Lisa A. Walsh began her college career in 1987 at Eastern Montana College in Billings, Montana. She transferred to Pacific University in 1991 and began professional courses in optometry. She earned a B.S. in Visual Science in 1992, and will graduate with a Doctor of Optometry degree in May, 1995. In addition to optometry, Lisa began primary flight lessons in May, 1992, and earned a private pilot certificate in September, 1992. She currently has about 120 total hours in small, single engine airplanes.

After graduation, Lisa plans to seek full time employment as an optometrist in Washington state. With an income to support her flying habit, she plans to gain many more hours in the air. Her goals include becoming instrument rated and learning aerobatics. Her ultimate goal is to work as an optometrist only part time and work as a primary flight instructor the rest of the time.
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Acknowledgments

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We thank Chris White, O.D., Ken Henderson, O.D. and James Murphy, O.D. for helping to review our final draft of the surveys. We are also grateful for the financial support that we received from Beta Sigma Kappa.

We would also like to thank all of the pilots and optometrists who took the time to complete and return the surveys.
Introduction

The patient in your chair explains that he is a pilot and needs form 8500-7 completed so that he will not need to have his vision evaluated by the AME. Can you take care of him? Or do you hope that the pilot brought this form with him and can tell you how to complete it?

To many optometrists, the vision requirements of pilots are something of a mystery. Do pilots have acuity, field, color or other vision requirements that are different from non-pilots? Do they need “occupational” lenses for the demands associated with flying an aircraft, and, if so, what are those demands?

To address these questions, optometrists and pilots from the Seattle, WA area were surveyed regarding the visual needs of pilots and their expectations of vision examinations and treatment. Following a basic review of the requirements for the various pilot certificates, results of the surveys will be presented.

Basic Background Information

There are four grades of pilot certificates: Student, Private, Commercial, and Airline Transport Pilot (ATP). Certain privileges are granted to the pilot based on the type of pilot certificate that he or she has earned. Student pilots are just learning and cannot carry passengers. Private pilots fly themselves and passengers, but cannot be paid for flying. Commercial pilots can be paid for flying and can carry paying passengers or become flight instructors. Airline Transport Pilots (ATP’s) can be captains of the large passenger jets of the airlines and are held to the highest standards in skill and responsibility.

In order to exercise the privileges of each pilot certificate, a pilot must have a current medical certificate. The medical certificate is obtained from an Aviation Medical Examiner (AME), who is a M.D. or D.O. with authority from the Federal Aviation Administration (FAA) to give flight physicals. There are three medical certificates: first-
class, second-class and third-class. The type of flying that a pilot does dictates the class of medical certificate that he or she must have. To exercise the privileges of an ATP, a first-class medical is required. However, an ATP only needs a class three medical if he or she only chooses to exercise the privileges of a private pilot. Likewise, a second-class medical certificate is required to exercise the privileges of a commercial pilot certificate, and a third-class medical for a private certificate.

Regulatory Vision Requirements of Pilots

The vision requirements for the three classes of medical certificates are outlined in the Federal Aviation Regulations (FAR's), Part 67: Medical Standards and Certification. An excerpt is included in Appendix A. These regulations are summarized in Table 1.

There are two FAA forms that may used for the vision examination. The first is Form 8500-7, "Report of Eye Evaluation." This form is used when the AME requires a pilot to have a complete vision examination because he or she has failed the vision portion of the medical certification examination. The form is also used when a pilot presents to the optometrist prior to his or her medical examination. This will allow the AME to skip the vision portion of his or her examination if the findings of the optometrist meet the requirements of the FAR's.

The second is Form 8500-14, "Ophthalmological Evaluation for Glaucoma." The purpose of this form is self-explanatory. With the advent of TPA's, the FAA will now accept this form from either an ophthalmologist or a qualified optometrist.
Visual Skills Used by Pilots

Pilots rely on their vision, whether in visual conditions or instrument conditions, as their primary means of controlling the aircraft. In visual conditions, the pilot relies on visual information obtained mostly from objects outside the aircraft, such as the ground. In instrument conditions, the pilot relies entirely on the visual information displayed on the instruments within the aircraft. In order for the pilot to use all this visual information accurately and efficiently, he or she must command a wide variety of visual skills.

To illustrate all of the visual demands encountered within the flight environment is beyond the scope of this paper. Several papers have been written which deal with these skills. The skills most often addressed include:

1. Visual acuity
2. Accommodation/ near VA/ presbyopia
3. Dynamic visual acuity
4. Contrast sensitivity
5. Dark adaptation
6. Depth perception/ stereopsis
7. Eye movements/ vergence/ phoria
8. Visual fields/ peripheral vision
9. Glare/ glare recovery
10. Color vision

There are other visual skills important for pilots which are more complex, often consisting of combinations of several visual skills. For these, clearly defined and adequately normed testing procedures have not been developed. These include spatial awareness, which uses peripheral vision cues as well as integration of visual information with information from the other senses. Other skills include temporal resolution, processing of visual information and perceptual organization. These are the skills often important for helping pilots to recognize and disregard the many illusions that could be encountered in flight.
Summary and Goals of the Project

The visual demands of aviators and the skills needed to meet those demands are highly varied. The data from the surveys will tell the extent of optometrists' knowledge of the visual needs and expectations of pilots. The data will be used to help reconcile the care optometrists provide to pilots with the needs and expectations of those pilots.

Methods

Surveys were mailed to 100 optometrists in the greater Seattle, Washington area. Their names were selected at random from the Blue Book of Optometrists. Separate surveys were sent to 120 pilots in the same region. The names were randomly selected from a mailing list purchased from Airpak, Inc. All surveys included a self-addressed, stamped envelope for return.

The surveys sent to the optometrists contained 21 questions divided into several areas: demographic data, knowledge of the Federal Aviation Regulations, considerations for vision examinations of pilots, and perception of vision-related issues of interest to pilots (Appendix B). Exclusion criteria for optometrists included any pilots, student pilots and persons with a specific background in aviation.

The surveys sent to pilots contained 22 questions which covered the following areas: demographic data, past vision examination experiences, expectations for a vision examination, and vision-related issues of interest to pilots (Appendix C). Exclusion criteria for pilots included any optometrists, ophthalmologists, opticians or persons with a specific background in the vision sciences.
Results: Optometrists

Demographic Data

Of the 100 surveys sent to optometrists, 87% went to male doctors; of the 40 total surveys returned, 92% were from males. Eighty-one percent of the respondents practiced in either solo or group settings, with the remainder working in HMO or commercial practices. Eleven of the respondents received their O.D. degrees prior to 1970, and 24 graduated later than 1970. Surveys returned by three optometrists met the exclusion criteria and were not included in further analysis. Thirty-seven surveys were evaluated for the study.

Knowledge of Federal Aviation Regulations

Optometrists were asked four "quiz-like" questions regarding pilot certificates, medical certificates, and vision requirements for pilots. The questions, responses and correct answers are shown in Table 2.

In addition, optometrists were asked to rate their knowledge of FAR vision requirements, and to compare their knowledge to that of their peers. On a scale of 1 to 10 with 1 being, "I've never heard of the FAA regulations," and 10 being, "I know them extremely well," the optometrists gave themselves a mean rating of 3.3, with responses ranging from 1 to 10. Seventy-five percent judged their knowledge to be equal to that of their peers. It was interesting to note that of the 8 optometrists who gave themselves a rating of 6 or higher for their knowledge of the FAA regulations, only one responded correctly to any of the four question dealing with specific FAA certification and vision requirements.
The optometrists also indicated that they were unprepared to supply pilots with appropriate FAA forms used to report the results of a vision examination. No respondents had the necessary forms available and only 30% indicated that they knew where to obtain them. Eighty-seven percent expected the pilots to bring any required forms with them to the examination.

Considerations for Vision Examinations of Pilots

On the average, optometrists said that 1.8% of their patients were pilots. When asked if they had ever spent time becoming familiar with the cockpit of any aircraft, 60% of the optometrists indicated they had not. To determine if optometrists tried to learn more about the pilot and his or her flight environment, they were asked several questions as shown in Table 3.

Table 4 shows responses of both optometrists and pilots to the question, "Which of the following do you feel should be tested more extensively for a civilian pilot than for a non-pilot?" The optometrists and pilots agreed on three main areas that should be tested more thoroughly for pilots: depth perception, peripheral vision and focusing ability. It is interesting, however, that only about a quarter of the optometrists approached the examination differently for pilots than for non-pilots, and less than 20% performed any special tests. Note also that when pilots were asked if they would be willing to pay extra for additional testing only 36% said they would.
Optometrists' Knowledge of Vision-Related Issues of Interest to Pilots

Optometrists were asked to rank a group of vision-related subjects which they believed pilots would have an interest. The pilots were asked a similar question. Table 5 shows the responses from both groups. The optometrists believed that pilots would be most interested in learning about multifocals, sun-glass tints, and contact lenses.

When optometrists were asked, "Do you believe that visual performance can be enhanced through vision training techniques for patients with 'normal' vision?" only 65% responded positively. Of that 65%, only 21% would recommend this type of vision training for pilots, and only 4% actually provided the service.

Results: Pilots

Demographic Data

Of the 45 total surveys returned, 93% were from males. The ages of the pilots surveyed were the following: nine (20.0%) were 16-30 years, eleven (24.4%) were 31-45 years and twenty-four (53.3%) were older than 46 years of age. One pilot (2.2%) did not give his age. Total flight hours of the respondents ranged from 90 to 26,000 hours, with an average of 6,847 hours. Flight hours within the last twelve months ranged from 0 to 1,000 hours, with an average of 250 hours. Private pilot certificates were held by fourteen (31.1%) of the pilots surveyed, while eleven (24.4%) had commercial certification and nineteen (42.2%) were ATP pilots. One pilot (2.2%) did not identify his certification level. Total certificates are greater than 100% due to multiple responses from pilots. When asked about the type of medical certificate they currently had, nineteen (42.2%) had Class I, eleven (24.4%) had Class II and fourteen
(31.1%) had Class III. One pilot (2.2%) did not respond to the question. None of the respondents met the exclusion criteria.

Past Experiences

About one-third of the pilots stated that their last vision examination (excluding the examination by an AME) was performed by an optometrist while another third saw an ophthalmologist. The remaining one-third could not recall if an optometrist or an ophthalmologist had performed the examination. About one-fourth of the pilots had their last vision examination less than one year ago. One-third had their examination one to three years ago while another one-third stated it was more than three years ago. Four of the pilots (8.8%) responded that they had never had a vision examination.

The pilots were asked several questions to determine if the doctor who provided their complete vision care had obtained enough background information to determine any special needs associated with flying. Table 6 shows the questions and the pilots' responses.

| Insert Table 6 about here |

Since the AME performs several vision tests during the course of a flight physical, the pilots were asked if they thought this was a complete vision examination. Thirty-five (78%) of them understood that it was not.

Table 7 lists the types of eye wear currently used by the pilots who responded to the survey. The pilots were asked if they had ever been prescribed glasses, sunglasses or contact lenses which were intended to be used for flying, but which did not work as intended. Five pilots (11%) stated that problems had occurred with their prescription lenses. One pilot wrote that his multifocals caused unexpected peripheral
vision blur and he had to turn his head too often to see the instruments. Two pilots had problems with the segment height and/or the range of intermediate or near vision with their multifocals.

Insert Table 7 About Here

Pilots' Expectations

The pilots were asked a series of questions about their expectations of an eye doctor. Their responses are summarized in Table 8. Most of the respondents (70%) indicated they were concerned that the doctor understood the importance of good vision to pilots, and how they use their eyes in flight. Prescribing the appropriate corrective lenses and eye wear is also important to 58% of the pilots. About half of the pilots expected their eye doctor to be knowledgeable about the FAA requirements and procedures, and over 40% of them thought the optometrist should have FAA forms available.

Insert Table 8 About Here

The pilots were also asked if they thought their vision examination should be the same or different than for a non-pilot. A majority of the pilots (58%) indicated that the examination should not be different. The optometrists and pilots agreed on three main areas that should be tested more thoroughly: depth perception, peripheral vision and focusing ability (see Table 4). When pilots were asked if they would be willing to pay extra for additional testing, only 36% said they would.
Although an annual vision examination by an optometrist or ophthalmologist is not required by the FAA, pilots were asked how often they thought a complete vision examination was necessary. Forty-seven percent thought that an examination was needed every two years. In contrast, 22% gave vague responses that ranged from, "When needed," to, "I don't want any more thorough than in place now." This response suggests that some pilots consider the vision portion of their medical to be sufficient. Pilot respondents expect a vision examination to take an average of 35 minutes (responses ranged from ten to ninety minutes). Note that optometrists surveyed performed their examinations in an average of 38 minutes.

Vision-Related Issues of Interest to Pilots

The pilots were also asked what factors might motivate them to seek a complete vision examination. Vision enhancement was ranked the highest among the issues of interest to pilots, but only 38% indicated that this would be a primary reason to visit an eye doctor. Sunglass tints were also high on the pilots' interest list, but only 22% said they would go to an eye doctor to obtain high quality sunglasses.

Seventy-one percent indicated that they would go to the eye doctor for a general eye health check-up and 49% would go to update their contact lens or spectacle prescriptions. Fear of failing, or actually failing the vision portion of the medical certification examination was not listed by pilots as a major reason for visiting an eye doctor. Surprisingly, only 1/3 of them indicated they would go to the eye doctor if this did occur.

The pilots were asked if they were aware of any accidents or incidents related to vision problems or inappropriate eyewear. Three of the pilots responded positively, noting that inappropriate sunglass tints such as blue-blocker type lenses might cause an inability to determine the color of some aircraft indicator lights. Also implicated were multifocal segment heights and/or poor frame shapes and sizes. Sneezing caused contact lens problems for one pilot.
Discussion

The goals of this project included: 1) determining pilots’ visual needs, expectations and interests; and 2) evaluating optometrists’ level of understanding of these needs and expectations. The data obtained can be used to help direct optometrists toward more appropriate care of pilot patients.

In general, the pilots indicated that they are most concerned that optometrists understand the importance of vision to pilots and that optometrists understand how pilots use their eyes in flight. More than half the pilots also expected their optometrist to understand the Federal Aviation Regulations. In addition, they indicated that in the past, these expectations may not have always been met.

Based on the responses given by the optometrists, they have at best a very limited understanding of FAA requirements. Optometrists’ and pilots responses did agree on the top three areas that might require more thorough testing for pilots. This suggests that optometrists do understand how pilots are using their eyes in flight. However, some familiarity with the FAA regulations on the part of the optometrist would greatly facilitate communication between optometrists and their pilot patients.

The indications by pilots of problems with multifocals suggest that it is necessary to work closely with presbyopic pilots to determine the exact distances at which they must work. Determination of how the multifocal segment might interfere with or aid pilots in their ability to view the instrument panel is critical. It is also important to note that instruments may be located overhead in some aircraft, and this might require the use of special occupational lens designs. In addition, optometrists can warn newly presbyopic pilots that bifocals might affect their ability to judge distance above the runway and recommend that the pilot seek extra training time until he or she adapts to the perceptions through the bifocal.16

Only a few pilots felt that their optometrist should be familiar with cockpit layouts, and very few optometrists indicated familiarity with any aircraft. Therefore, the
responsibility lies with the pilot to educate his or her optometrist as to the viewing distances and directions in the aircraft they fly. There are far too many different aircraft types for optometrists to assume responsibility for familiarity with all of them.

Other problems noted by the pilots included poor frame shapes and sizes causing reduced peripheral vision. The optometrist can help the pilot by guiding him or her to select frames that will not interfere with peripheral vision and that will allow an appropriate area for any needed add(s). Optometrists can also suggest proper sunglass tints that will not interfere with color discrimination or cause distortion when viewing through aircraft windshields, as can occur with polarized lenses. It can also be suggested that each pilot have multiple pairs of spectacles for daytime and night use as well as for backup in case glasses are lost or misplaced.

Failure of the vision portion of the medical certification process requires that the pilot get a vision evaluation from an optometrist or ophthalmologist if the certification is to be considered. Since only a third of the pilots indicated they would visit an eye doctor if they did fail the vision part of their medical examination, they may not be aware of the protocol for obtaining a waiver. If a pilot fears that he may fail the vision part of the medical certification, then seeing an optometrist prior to the medical examination can assist in the process. The optometrist who is familiar with the pilot's requirements can prescribe the necessary lenses or complete the FAA Form 8500-7, "Report of Eye Evaluation" should a waiver be needed. This can do a great deal to speed up the process and make the pilot happier.

When questioned about vision care issues thought to be of interest to pilots, the responses of optometrists did not closely parallel those of pilots. Optometrists believed that pilots were most interested in multifocals, sunglass tints and contact lenses. Not surprisingly, optometrists selected the three main items that most practices provide. In contrast, pilots were most interested in vision enhancement techniques, radial keratotomy and sunglass tints. Since pilots expressed an interest in vision enhancement, an alternative that few ophthalmologists can provide, optometrists are in
the unique position to provide a service to pilots they cannot get anywhere else. However, not many optometrists indicated that they would recommend vision enhancement to pilots, and less than 4% of the optometrists surveyed actually provide the service.

Radial keratotomy as an alternative is not a preferred method to recommend to pilots for several reasons. Pilots considering a career in the military should be made aware that radial keratotomy will likely disqualify them. The major airlines vary in their policies on radial keratotomy so a pilot anticipating a career with the airlines should carefully research the acceptance of the procedure by the various companies. The greatest concern regarding radial keratotomy and flying is the level of uncorrected acuity after the procedure.¹⁸

Conclusions

Since the percentage of pilots within an optometrist's patient base was reported on average to be just under two percent, and the proportion of pilots to non-pilots in the overall population is very small, the average optometrist will not see a large number of pilots.⁶ However, when a pilot does present, every optometrist should be prepared to meet the needs of that patient. At least some familiarity with FAA regulations and an awareness of issues the pilot may want to address will improve communication, and may result in referrals of other pilots. Pilots are particular about their vision care, and will seek out knowledgeable practitioners.¹⁶
Table 1: Federal Aviation Regulations (FAR), Part 67
Vision Requirement Summary

<table>
<thead>
<tr>
<th>Class of Medical Certification</th>
<th>First - Class Airline Transport Pilot</th>
<th>Second - Class Commercial Pilot</th>
<th>Third - Class Private Pilot</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISTANT VISION</td>
<td>20/20 in each eye separately without correction or at least 20/100 in each eye separately corrected to 20/20 or better with corrective lenses (glasses or contacts).</td>
<td>At least 20/50, without correction; or if vision is poorer than 20/50, must correct to 20/30 or better with corrective lenses (glasses or contact lenses).</td>
<td></td>
</tr>
<tr>
<td>NEAR VISION*</td>
<td>At least 20/40 in each eye separately with or without correcting glasses.</td>
<td>At least 20/60 in each eye separately with or without correcting glasses.</td>
<td></td>
</tr>
<tr>
<td>HYPERPHORIA</td>
<td>Maximum of 1 diopter.</td>
<td>No standard.</td>
<td></td>
</tr>
<tr>
<td>ESOPHORIA/EXOPHORIA</td>
<td>Maximum of 6 diopters of esophoria or exophoria.</td>
<td>No standard.</td>
<td></td>
</tr>
<tr>
<td>COLOR VISION</td>
<td>Normal color vision.</td>
<td>Ability to distinguish aviation signal red, aviation signal green and white.</td>
<td></td>
</tr>
</tbody>
</table>

*The FAA is currently proposing stricter near vision standards. They are proposing a minimum of 20/40 at 16 inches, or 20/40 at 32 inches if age 50 or older, for first- and second-class medical medicals. A near vision acuity of 20/40 at 16 inches would be required for third-class medicals.\(^2\)
<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
<th>Correct Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are the four grades of civilian pilot certifications (excluding student pilot)?</td>
<td>Unknown 100.0% (37)</td>
<td>Recreational, Private, Commercial, ATP</td>
</tr>
<tr>
<td>How many different types of medical certificates for pilots are there?</td>
<td>Unknown 100.0% (37)</td>
<td>Three. Classes I, II, III</td>
</tr>
<tr>
<td>Is a comprehensive vision examination required for all civilian pilots?</td>
<td>Yes 29.7% (11)</td>
<td>No. Vision is tested by the aviation medical examiner.</td>
</tr>
<tr>
<td></td>
<td>No 27.0% (10)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unknown 43.2% (16)</td>
<td></td>
</tr>
<tr>
<td>What is the worst distance visual acuity in the poorer eye that a private pilot can have and still be medically certified to fly without corrective lenses?</td>
<td>Unknown 94.6% (35)</td>
<td>20/50</td>
</tr>
</tbody>
</table>
Table 3: When you have a patient who is a civilian pilot, which of the following do you do? (n = 37)

<table>
<thead>
<tr>
<th>Question</th>
<th>Percent</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ask about required viewing distances within the aircraft?</td>
<td>91.9%</td>
<td>(34)</td>
</tr>
<tr>
<td>Ask about viewing directions (i.e. eye level, above or below eye level)?</td>
<td>70.3%</td>
<td>(26)</td>
</tr>
<tr>
<td>Approach the exam differently than for a non-pilot?</td>
<td>27.0%</td>
<td>(10)</td>
</tr>
<tr>
<td>Perform any additional tests not regularly performed on non-pilot patients?</td>
<td>18.9%</td>
<td>(7)</td>
</tr>
<tr>
<td>Other*</td>
<td>10.8%</td>
<td>(4)</td>
</tr>
<tr>
<td>None of the above</td>
<td>5.4%</td>
<td>(2)</td>
</tr>
</tbody>
</table>

*Multiple answers (total responses > 100%)

**Responses included: Suggesting Double D segs, approaching each pilot differently based upon visual needs, determining location of controls especially overhead and to the side, and performing a meticulous refraction.
Table 4: Which of the following do you feel should be tested more extensively for a civilian pilot than for a non-pilot?

<table>
<thead>
<tr>
<th>Eye test</th>
<th>Optometrist Survey</th>
<th>Pilot Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n = 37 )</td>
<td>( n = 45 )</td>
</tr>
<tr>
<td>Eye disease check</td>
<td>8.1% (3)</td>
<td>31.1% (14)</td>
</tr>
<tr>
<td>Eye movements</td>
<td>24.3% (9)</td>
<td>35.6% (16)</td>
</tr>
<tr>
<td>Focusing ability</td>
<td>32.4% (12)</td>
<td>68.9% (31)</td>
</tr>
<tr>
<td>Peripheral vision (fields)</td>
<td>51.4% (19)</td>
<td>73.3% (33)</td>
</tr>
<tr>
<td>Glare testing</td>
<td>24.3% (9)</td>
<td>28.9% (13)</td>
</tr>
<tr>
<td>Color vision</td>
<td>29.7% (11)</td>
<td>53.3% (24)</td>
</tr>
<tr>
<td>Dark adaptation</td>
<td>16.2% (6)</td>
<td>55.6% (25)</td>
</tr>
<tr>
<td>Hand-eye coordination</td>
<td>13.5% (5)</td>
<td>35.6% (16)</td>
</tr>
<tr>
<td>Depth perception</td>
<td>40.5% (15)</td>
<td>80.0% (36)</td>
</tr>
<tr>
<td>Coordinated use of both eyes together</td>
<td>29.7% (11)</td>
<td>51.1% (23)</td>
</tr>
<tr>
<td>None</td>
<td>21.6% (8)</td>
<td>15.6% (7)</td>
</tr>
</tbody>
</table>
Table 5: Pilot’s Vision Interests

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Optometrist Survey (n = 37)</th>
<th>Pilot Survey (n = 45)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Multifocals</td>
<td>Vision enhancement</td>
</tr>
<tr>
<td>#2</td>
<td>Sunglass tints</td>
<td>Sunglass tints</td>
</tr>
<tr>
<td>#3</td>
<td>Contact lenses</td>
<td>Radial Keratotomy</td>
</tr>
<tr>
<td>#4</td>
<td>Vision enhancement</td>
<td>Contact lenses</td>
</tr>
<tr>
<td>#5</td>
<td>Radial Keratotomy</td>
<td>Color vision,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multifocals (tie)</td>
</tr>
<tr>
<td>#6</td>
<td>Color vision</td>
<td></td>
</tr>
<tr>
<td>#7</td>
<td>Cataracts</td>
<td>Glaucoma</td>
</tr>
<tr>
<td>#8</td>
<td>Glaucoma</td>
<td>Definition: OD vs. MD</td>
</tr>
<tr>
<td>#9</td>
<td>Definition: OD vs. MD</td>
<td>Cataracts</td>
</tr>
</tbody>
</table>
Table 6: At your last exam, did the doctor:

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Know or find out you were a pilot?</td>
<td>62.2% (28)</td>
<td>22.2% (10)</td>
</tr>
<tr>
<td>Seem interested in your flying?</td>
<td>37.8% (17)</td>
<td>33.3% (15)</td>
</tr>
<tr>
<td>Ask how you use your eyes in flight?</td>
<td>24.4% (11)</td>
<td>51.1% (23)</td>
</tr>
<tr>
<td>Listen to your past or present vision vision problems?</td>
<td>53.3% (24)</td>
<td>22.2% (10)</td>
</tr>
<tr>
<td>Suggest special glasses for flying only?</td>
<td>15.6% (7)</td>
<td>62.2% (28)</td>
</tr>
<tr>
<td>Discuss sunglasses with you?</td>
<td>15.6% (7)</td>
<td>57.7% (26)</td>
</tr>
</tbody>
</table>

*Total responses do not equal 100% because not all pilots responded or answered ‘unknown’.
Table 7: Eyewear worn by pilots for flying*

<table>
<thead>
<tr>
<th>Eyewear Type</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-prescription sunglasses</td>
<td>48.9%</td>
<td>(22)</td>
</tr>
<tr>
<td>Prescription glasses</td>
<td>35.6%</td>
<td>(16)</td>
</tr>
<tr>
<td>Bifocal prescription glasses</td>
<td>15.6%</td>
<td>(7)</td>
</tr>
<tr>
<td>No-line bifocals</td>
<td>13.3%</td>
<td>(6)</td>
</tr>
<tr>
<td>Trifocal prescription glasses</td>
<td>13.3%</td>
<td>(6)</td>
</tr>
<tr>
<td>Prescription sunglasses</td>
<td>11.1%</td>
<td>(5)</td>
</tr>
<tr>
<td>Contact lenses</td>
<td>6.7%</td>
<td>(3)</td>
</tr>
<tr>
<td>Other**</td>
<td>15.6%</td>
<td>(7)</td>
</tr>
<tr>
<td>None of the above</td>
<td>13.3%</td>
<td>(6)</td>
</tr>
</tbody>
</table>

*Multiple answers (total responses > 100%)

**Includes drugstore half-eyes, photogrey lenses and occasional wear.
Table 8: Pilots' Expectations of Optometrists*

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Know the Federal Aviation vision requirements?</td>
<td>51.1% (23)</td>
</tr>
<tr>
<td>Understand the different requirements of Class I, II and III medical certificates?</td>
<td>51.1% (23)</td>
</tr>
<tr>
<td>Know the differences among recreational, private, commercial and ATP pilots?</td>
<td>35.6% (16)</td>
</tr>
<tr>
<td>Know when a vision waiver is appropriate?</td>
<td>46.7% (21)</td>
</tr>
<tr>
<td>Know how to assist you in obtaining a waiver for your vision?</td>
<td>42.2% (19)</td>
</tr>
<tr>
<td>Have the necessary FAA forms available?</td>
<td>42.2% (19)</td>
</tr>
<tr>
<td>Be familiar with aircraft cockpit layouts?</td>
<td>22.2% (10)</td>
</tr>
<tr>
<td>Understand how pilots use their eyes in flight?</td>
<td>62.2% (28)</td>
</tr>
<tr>
<td>Recommend more appropriate corrective lenses/eyewear for flying?</td>
<td>57.8% (26)</td>
</tr>
<tr>
<td>Understand the importance of good vision for pilots?</td>
<td>68.9% (31)</td>
</tr>
<tr>
<td>None of the above.</td>
<td>15.6% (7)</td>
</tr>
</tbody>
</table>

*Total responses > 100%
PART 67 -- MEDICAL STANDARDS AND CERTIFICATION

67.13 First-class medical certificate.

(a) To be eligible for a first-class medical certificate, an applicant must meet the requirements of paragraphs (b) through (f) of this section.

(b) Eye:
   (1) Distant visual acuity of 20/20 or better in each eye separately, without correction; or of at least 20/100 in each eye separately corrected to 20/20 or better with corrective lenses (glasses or contact lenses) in which case the applicant may be qualified only on the condition that he wears those corrective lenses while exercising the privileges of his airman certificate.
   (2) Near vision of at least \( v = 1.00 \) at 18 inches with each eye separately, with or without corrective glasses.
   (3) Normal color vision.
   (4) Normal fields of vision.
   (5) No acute or chronic pathological condition of either eye or adenexae that might interfere with its proper function, might progress to that degree, or might be aggravated by flying.
   (6) Bifoveal fixation and vergencephoria relationship sufficient to prevent a break in fusion under conditions that may reasonably occur in performing airman duties.

Tests for the factors named in paragraph (b)(6) of this section are not required except for applicants found to have more than one prism diopter of hyperphoria, six prism diopters of esophoria, or six prism diopters of exophoria. If these values are exceeded, the Federal Air Surgeon may require the applicant to be examined by a qualified eye specialist to determine if there is bifoveal fixation and adequate vergencephoria relationship. However, if the applicant is otherwise qualified, he is entitled to a medical certificate pending the results of the examination.

67.15 Second-class medical certificate.

(a) To be eligible for a second-class medical certificate, an applicant must meet the requirements of paragraphs (b) through (f) of this section.

(b) Eye:
   (1) Distant visual acuity of 20/20 or better in each eye separately, without correction; or of at least 20/100 in each eye separately corrected to 20/20 or better with corrective lenses (glasses or contact lenses), in which case the applicant may be qualified only on the condition that he wears those corrective lenses while exercising the privileges of his airman certificate.
(2) Enough accommodation to pass a test prescribed by the Administrator based primarily on ability to read official aeronautical maps.
(3) Normal fields of vision.
(4) No pathology of the eye.
(5) Ability to distinguish aviation signal red, aviation signal green, and white.
(6) Bifoveal fixation and vergencephoria relationship sufficient to prevent a break in fusion under conditions that may reasonably occur in performing airman duties.

Tests for the factors named in paragraph (b)(6) of this section are not required except for applicants found to have more than one prism diopter of hyperphoria, six prism diopiers of esophoria, or six prism dippers of exophoria. If these values are exceeded, the Federal Air Surgeon may require the applicant to be examined by a qualified eye specialist to determine if there is bifoveal fixation and adequate vergencephoria relationship. However, if the applicant is otherwise qualified, he is entitled to a medical certificate pending the results of the examination.

67.17 Third-class medical certificate.

(a) To be eligible for a third-class medical certificate, an applicant must meet the requirements of paragraphs (b) through (f) of this section.
(b) Eye:
(1) Distant visual acuity of 20/50 or better in each eye separately, without correction; or if the vision in either of both eyes is poorer than 20/50 and is corrected to 20/30 or better in each eye with corrective lenses (glasses or contact lenses), the applicant may be qualified on the condition that he wears those corrective lenses while exercising the privileges of his airman certificate.
(2) No serious pathology of the eye.
(3) Ability to distinguish aviation signal red, aviation signal green, and white.
Appendix B

OPTOMETRIST SURVEY

PLEASE REMEMBER TO FINISH THE FRONT AND THE BACK PAGE. DO NOT WRITE YOUR NAME OR ADDRESS ON THE SURVEY AS ALL INFORMATION IS KEPT ANONYMOUS. YOUR HELP IS GREATLY APPRECIATED!

1. When you have a patient that is a civilian pilot, which of the following do you do? (Mark all that apply)
   □ Ask about required viewing distances within the aircraft?
   □ Ask about viewing directions (i.e. eye level, above or below eye level)?
   □ Approach the exam differently than for a non-pilot?
   □ Perform any additional tests not regularly performed on non-pilot patients?
   □ Other: ____________________________________________
   □ None of the above.

2. Have you ever spent time becoming familiar with the cockpit of any aircraft?
   □ Yes
   □ No

3. Estimate the percent of your patients that are civilian pilots: _________%

4. How long does your average complete vision exam take? (Estimate) ____________________________________________

5. Which of the following do you feel should be tested more extensively for a civilian pilot than a non-pilot: (Mark all that apply)
   □ Eye disease check
   □ Eye movements
   □ Focusing ability
   □ Peripheral vision (fields)
   □ Glare testing
   □ Color vision
   □ Dark Adaptation
   □ Hand-Eye Coordination
   □ Depth Perception
   □ Coordinated use of both eyes together
   □ Other: ____________________________________________
   □ None

6. For any items you marked in the previous question, place a second mark by those items which are not included in your standard exam and/or require an extra fee. (QUESTION OMITTED DUE TO MINIMAL RESPONSE)
7. Number the following in the order that you believe pilots are most interested in. (#1 being “most interested”)

- Color Vision
- Contact Lenses
- Radial Keratotomy (RK)
- Cataracts, Cataract Surgery
- Vision Enhancement techniques
- Bifocals, Trifocals, No-line bifocals
- Protective sunglass tints
- Glaucoma
- The difference between an optometrist and ophthalmologist
- Other: __________________________

8. Do you believe that visual performance can be enhanced through vision training techniques for patients with “normal” vision (20/20, normal binocularity, full fields, etc.)?
   - □ No
   - □ Yes:
     - a. Do you recommend this type of vision training to civilian pilots?
        - Yes
        - No
     - b. Do you provide this type of vision training in your office?
        - Yes
        - No

9. Do you have relevant Federal Aviation Administration (FAA) forms (Form 8500-7 and Form 8500-14) in your office?
   - □ Yes
   - □ No

10. If you do not have these forms, do you know where to obtain them?
    - □ Yes
    - □ No

11. Do you expect the pilot patient to bring the appropriate FAA forms to their exam?
    - □ Yes
    - □ No

TO HELP DETERMINE OPTOMETRISTS’ GENERAL KNOWLEDGE OF FEDERAL AVIATION REGULATIONS, PLEASE ANSWER THE FOLLOWING QUESTIONS TO THE BEST OF YOUR ABILITY. PLEASE MARK “UNKNOWN” IF YOU HONESTLY JUST DON’T KNOW THE ANSWER.

12. What are the four grades of civilian pilot certificates (excluding student pilots)?
    - □ Unknown

   ____________________________________________
   ____________________________________________
   ____________________________________________

13. Is a comprehensive vision examination by an optometrist or ophthalmologist required for all civilian pilots?
    - □ Yes
    - □ No
    - □ Unknown
14. How many different types of medical certificates for civilian pilots are there?

_____ or □ Unknown

15. What is the worst distance visual acuity in the poorer eye that a private pilot can have and still be medically certified to fly without corrective lenses?

□ 20/20 □ Unknown
□ 20/30
□ 20/40
□ 20/50

16. After answering these questions, and based on your previous knowledge, rate your own knowledge of the Federal Aviation Regulation vision requirements. Use a scale of 1-10, with 1 being, "I've never heard of them" and 10 being, "I know them extremely well." (Circle one)

1--2--3--4--5--6--7--8--9--10

17. Compared to optometrists in general, is your personal knowledge of Federal Aviation Regulation vision requirements: (Circle one)

LESS-----EQUAL-----MORE

The following information will be used only for the purpose of sorting the surveys.

18. Are you a pilot? □ No □ Yes

a. What class of medical certificate do you hold?

b. What are your ratings?

c. What is your total time? __________

Time in last 12 months? __________

19. What is your gender? □ Male □ Female

20. What year did you graduate from optometry school? __________

21. Which of the following best describes your practice setting?

□ Solo practice
□ Group practice
□ HMO
□ Corporate (chain)
□ Other: ________________________________
Thank you for participating!

If you have any specific questions or concerns regarding this survey, please attach a separate sheet of paper with your name and address included so that we may respond directly to you.
Appendix C

PILOT SURVEY

PLEASE REMEMBER TO FINISH THE FRONT AND THE BACK PAGE. DO NOT WRITE YOUR NAME OR CERTIFICATE NUMBER ON THE SURVEY AS ALL INFORMATION IS KEPT ANONYMOUS. YOUR HELP IS GREATLY APPRECIATED!

1. Other than the few eye tests performed for your FAA medical, when was the last time you had a complete vision exam performed by an eye doctor?
   - □ Less than 1 year ago
   - □ More than 3 years ago
   - □ 1-3 years ago
   - □ Never → Skip to question 4

2. Was the exam done by an:
   - □ Optometrist
   - □ Ophthalmologist
   - □ Unknown

3. At your last complete vision exam, did the eye doctor: (Circle the appropriate answer)
   a. Know or find out that you are a pilot? □ yes □ no □ unknown
   b. Seem interested in your flying? □ yes □ no □ unknown
   c. Ask how you use your eyes in flight? □ yes □ no □ unknown
   d. Listen to your past or present vision problems? □ yes □ no □ unknown
   e. Suggest special glasses for flying only? □ yes □ no □ unknown
   f. Discuss sunglasses with you? □ yes □ no □ unknown

4. Which of the following do you currently use for flying? (Check all that apply)
   - □ Prescription glasses
   - □ Bifocal prescription glasses
   - □ Prescription sunglasses
   - □ No-line bifocals
   - □ Non-prescription sunglasses
   - □ Trifocal prescription glasses
   - □ Contact lenses
   - □ Other: ____________________________
   - □ None of the above

5. Have you ever failed a medical due to a vision or eye health problem?
   - □ No
   - □ Yes (please explain)

6. Have you ever been prescribed glasses, sunglasses or contact lenses which were intended to be used for flying, but did not work well?
   - □ No
   - □ Yes (please explain)
7. Do you expect an eye exam for a pilot to be the same or different than an eye exam for a non-pilot?
   □ Same  □ Different

8. Do you believe that the vision portion of your medical exam is a complete vision exam?
   □ Yes  □ No

9. How long do you expect a complete eye exam to take? (estimate)
   ________________________________

10. How often do you believe that a pilot should have a complete vision exam performed by an optometrist or ophthalmologist?
    □ Every year  □ Every 2 years  □ Other:
    ________________________________

11. Which of the following do you expect to be tested more extensively for a pilot than for a non-pilot: (Mark all that apply)
    □ Eye disease check  □ Color vision
    □ Eye movements  □ Dark Adaptation
    □ Focusing ability  □ Hand-Eye Coordination
    □ Peripheral vision (Fields)  □ Depth Perception testing
    □ Glare testing  □ Coordinated use of both eyes together
    □ Other: ________________________________
    □ None

12. Would you be willing to pay extra for these additional tests (see question #11) if they are not included in a standard (non-pilot) vision exam?
    □ Yes  □ No

13. Which of the following do you expect of an eye doctor? (Mark all that apply)
    □ To know the Federal Aviation Regulation vision requirements?
    □ To understand the different requirements of Class I, II and III medical certificates?
    □ To know the differences among recreational, private, commercial and ATP pilots?
    □ To know when a vision waiver is appropriate?
    □ To know how to assist you in obtaining a waiver for your vision?
    □ To have the necessary FAA forms available?
    □ To be familiar with aircraft cockpit layouts?
    □ To understand how pilots use their eyes in flight?
    □ To recommend more appropriate corrective lenses/eyewear for flying?
    □ To understand the importance of good vision for pilots?
☐ None of the above.

14. Why might you go to an eye doctor? (Mark all that apply)
☐ To update contact lenses or glasses that you currently use?
☐ If you have failed the vision part of your medical?
☐ If you fear that you might fail the vision part of your medical?
☐ To enhance or improve your vision?
☐ For a general eye health check-up?
☐ To get appropriate high-quality sunglasses for flying?
☐ For information on refractive surgery or radial keratotomy (RK)?
☐ Other: __________________________________________________________
☐ None

15. Place these in the order you would be most interested in learning more about.
   (#1 is "most interested")
   ____ Color Vision
   ____ Contact Lenses
   ____ Radial Keratotomy (RK)
   ____ Cataracts, Cataract Surgery
   ____ The difference between an optometrist and ophthalmologist
   ____ Vision Enhancement techniques
   ____ Bifocals, Trifocals, No-line bifocals
   ____ Protective sunglass tints
   ____ Glaucoma
   ____ Other: ________________________________________________________

16. Are you aware of any accidents or incidents due to inappropriate eyewear or vision problems?
☐ No ☐ Yes. Please explain: ____________________________________________

The following information will be used only for the purpose of sorting the surveys.

17. Are you an: ☐ Optometrist ☐ Ophthalmologist ☐ Optician ☐ None of these

18. What is your gender? ☐ Male ☐ Female

19. What is your age range? ☐ 16-30 years ☐ 31-45 years ☐ 46+ years

20. Which airmen certificate do you hold?
☐ Recreational ☐ Private ☐ Commercial ☐ ATP

21. What is your total time? _______ Time in last 12 months? _______

What class of medical certificate do you hold? ☐ Class I ☐ Class II ☐ Class III
Thank you for participating!

If you have any specific questions or concerns regarding this survey, please attach a separate sheet of paper with your name and address included so that we may respond directly to you.
Footnotes

a. FAA Form 8500-7, “Report of Eye Evaluation”, may be obtained from the nearest Regional Flight Surgeons Office (Department of Transportation, Federal Aviation Administration) by phone. Forms can be photocopied for future use.


c. The most recent (1992) pilot figures for the United States obtained by personal communication with AOPA (Aircraft Owners and Pilots Association; Frederick, Maryland) are as follows: 114,597 had student certification, 288,078 had private certification, 146,385 had commercial certification and 115,855 were ATP certified.
References


