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DISTRIBUTION OF VISUAL CHARACTERISTICS OF NAVAL AVIATION PERSONNEL

Annette G. Baisden and William A. Monaco

August 1983

NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY
PENSACOLA, FLORIDA

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Naval Medical Research and Development Command
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5 August 1983

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SUMMARY PAGE

THE PROBLEM

Failure to meet required visual standards provides a significant source of rejections to naval aviation training and of disqualifications of designated aviators for Service Group I. It is important to assure these standards represent the visual abilities which are critical to mission performance, and to assure their proper application throughout the aviator's service career. The purpose of this report is to assess the visual characteristics of stratified samples (active duty and retired) within the naval aviation community through the examination of health records, to determine the distribution of those characteristics, and to identify those characteristics that have been noted to change during the course of the naval aviator's career.

FINDINGS

The following findings were based on a study of the records of 839 physical examinations of 72 active duty and retired naval aviators. Distant visual acuity, near visual acuity, and accommodative amplitude decreased with age. There was a trend toward increased myopia during operational flying years. Against-the-rule astigmatism increased with age. Throughout the naval aviator's career, fusion-related variables remained stable and intraocular pressure was normal.

ACKNOWLEDGEMENTS

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INTRODUCTION

Failure to meet required visual standards provides a significant source of rejections of applicants to naval aviation training and disqualifications of designated naval aviators for Service Group I. Service Group I aviators are considered medically qualified for any type of flying. To eliminate questions of standards and maximize human resources, it is important to assure that these standards represent the visual abilities which are critical to mission performance and to assure their proper application throughout the service career of the aviator.

Administrative action has been based, in part, upon assumed changes in visual capabilities as a function of chronological age. The age criteria which automatically removed the 45 year old aviator from Service Group I were eliminated in 1980. This action further emphasized the need to evaluate alternatives to chronological age as a determinant for flying classification, develop alternative or improved systems of monitoring examinations, and determine if improved predictive systems can be formulated from these data (1).

There is a considerable literature which documents the general decline of visual performance with age. Many of the affected visual functions are considered to be important to naval aviation missions. The loss of accommodative amplitude is perhaps the most apparent of these changes (2,3,4,5). Although this area of decrement can be ameliorated by the use of spectacles, loss of accommodative amplitude is the visual decrement most frequently cited in defense of reclassification at age 45. Visual acuity, the ability to resolve detail, also declines with age (6) and can be corrected. Other types of decrements in visual performance are not as easily remedied.

Although many types of visual performance are known to decline with age, there are large individual differences in decrement with age groups, and differences in rates at which decrements occur. The degree to which the effects of these changes upon performance may be compensated by experience is unknown. It is important, therefore, to base the selection or reclassification of individuals upon their own performance capabilities.

Difficulties exist in extrapolating findings obtained with the general population of subjects to military pilots. These are due in part to differences in health care, nutrition, and motivation.

The purpose of this report is to 1) assess the visual characteristics of stratified samples within the naval aviation community (active duty and retired) through the examination of health records, 2) determine the distribution of those characteristics, and 3) identify those visual characteristics that have been noted to change during the course of the naval aviator's career.

Future efforts will be directed toward determining the predictability of degredation in these abilities and individual differences among naval aviation personnel.

PROCEDURE

Eight-hundred thirty-nine physical examinations of 72 active duty and retired naval aviators were randomly selected from the Naval Aerospace Medical Institute's extensive medical record library. They were reviewed to determine the distribution of visual characteristics throughout the service career of naval aviators. Specifically, the data were derived from the Standard Form 88 (SF88), Report of Medical Examination, and were as follows:

. Age -Age in years to the nearest birthday at time of the physical examination.

. Distant Vision Right Eye (OD) Left Eye (OS)	-Acuity - resolving power of the eye at 20 feet. Tested using the Armed Forces Vision Tester (AFVT) or Snellen Eye Chart and expressed solely by the Snellen fraction denominator.
. Refraction	
Sphere - OD, OS	-Lens power expressed in diopters needed to correct refractive error.
Cylinder - OD, OS	-Lens power expressed in diopters needed to correct astigmatism.
Axis - OD, OS	-Identifies cylindrical power location within the lens.
. Corrected Distant Vision-OD, OS	-Distant visual acuity measured with optical correction and expressed as Snellen fraction denominator.
. Near Vision - OD, OS	-Acuity - resolving power of the eye at 16 inches (or 40cms). Tested using the Armed Forces Vision Tester or Snellen near-point cards and expressed as Snellen fraction denominator.
. Add - OD, OS	-Spectacle bifocal power.
. Corrected Near Vision - OD, OS	-Acuity-resolving power of the eye at near measured with optical correction and expressed as Snellen fraction denominator.
. Accommodation-OD, OS	-The ability of the eye to increase its refractive power through the action of the ciliary muscle upon the lens, making it assume a more spherical shape.
. Heterophoria	-A deviation which occurs when fusion is interrupted. Measured by the AFVT, Maddox Rod, or Cover Test and recorded in prism diopters.
Esophoria	-The eye under occlusion turns in.
Exophoria	-The eye under occlusion turns out.
. Prism Divergence	-Amount the eyes are able to diverge against the pull of a base-in prism and still maintain fusion. Tested at near (13") and far (20') using Risley Prisms and expressed in prism diopters.
. Near Point of Convergence (PC)	-Closest point at which the eyes can maintain binocular fixation. The distance is measured using a meter stick or Prince Rule and target light or pin with 2mm white head and is expressed in millimeters from spectacle plane

where the subject sees double or one eye deviates outward.

Intraocular Tension - OD, OS	-Intraocular pressure measured with Schiotz or Applanation or NCT tonometer and expressed in millimeters of mercury.

All aviation personnel must pass the test for stereopsis and color vision; therefore, these tests, which are recorded in terms of pass/fail, were not considered. Visual field data were not included, since testing is not required routinely and all recorded data were normal.

The ages at the time of the physical examination of the 72 randomly selected subjects ranged from 17 years to 62 years. The data included pre-flight, annual flight, and retirement physicals. The number of examinations per subject ranged from 5 to 30 with an average of 12. The total number of examinations was 839. The career length of time from the initial data entry in the medical record to the last entry ranged from 9 years to 37 years with an average of 23 years. The earliest physical was given in 1941 and the latest was given in 1982.

The medical examinations were sorted by age and evaluated by means of cross-sectional analysis. Descriptive analyses (means, standard deviations) were conducted on each age for the variables listed above.

RESULTS AND DISCUSSION

Distant Visual Acuity

Entrance standards for naval aviation require 20/20 vision; therefore, none of the examinations for the early ages shows acuity worse than 20/20. If the acuity is better than 20/20, procedural specifications do not require a notation of how much better; therefore, the data do not give an indication of the numbers of people with better than 20/20 vision. After designation as a naval aviator, the minimum distant visual acuity is 20/50 (correctable to 20/20 both eyes) to remain in Service Group I. Service Group I aviators may fly all types of aircraft and land on carriers. Service Group II aviators may fly all types of aircraft but are restricted from carrier landings. They must have a minimum uncorrected acuity of 20/100. Service Group III aviators must fly accompanied by Service Group I aviators and have a minimum acuity of 20/200, (uncorrected), correctable to 20/20.

Table I presents the distant visual acuity data by age for the 72 naval aviators. The means and standard deviations of the Snellen fraction denominator with a given numerator of 20 are given for the right and left eye with and without correction. The data show a mild decrease in visual acuity with age. Most clinical observers note an initial decline at age 40 and a gradual loss from that age onward (7). The number of records examined for the older individuals was small; therefore, the data should be interpreted cautiously. For all ages acuity was correctable to 20/20 or better. Comparative analyses of distant visual acuity for the right eye and left eye were not performed; however, there do not appear to be large differences.

Refractive Error

Table II presents the means and standard deviations of refractive error by age. The majority of medical records did not indicate whether the examinations were cycloplegic or manifiest or subjective or objective. The data indicate a mild increase in myopia at key operational years. With age, there is a trend toward against-the-rule astigmatism (8), and these data reflect that trend.

Current refractive standards for student naval aviators are--Total (cycloplegic): 2.5D hyperopia, -.25D myopia, 0.75 astigmatism and for Service Group I--Total (manifest): -1.25D. Since the trend is toward increasing myopia with age, the entrant with -.25D refractive error may theoretically develop a need for as much as a 2.00D correction for myopia by the end of his career. If the standard were modified and the zone restricted to hyperopia, it is possible that the attrition from induced myopia could be reduced with resultant increase in duration in Service Group I status in an aviator's career.

Near Visual Acuity

Due to presbyopia, reduced near visual acuity occurs between the ages of 38 and 42 and decreases from that age at a fairly standard rate (9). Near visual acuity data for aviation personnel are presented in Table III. These data show the decrease in near visual acuity parallelling decreasing accommodative amplitude. In general, the bifocal adds are comparable or somewhat lower than the standard adds for their given age category. Vision standards for aviation personnel require 20/20 unaided at entrance. Near vision standards for the three Service Groups must be at least 20/200 corrected to 20/20. Unaided and aided near visual acuity data are presented in the table.

Accommodation

Table IV presents "accommodation" by age as measured by the Prince Rule. "Accommodation" is written in quotes since the Prince Rule does not actually measure accommodation, but measures accommodation plus or minus refractive error (10). Currently there are no standards for accommodation. Formerly, applicants for flight training were required to be within 3 diopters of the standards for their age. Aviators were required to have a minimum of 2.5 diopters of accommodation or be corrected to the amount. Qualifying results are acceptable from tests of near vision and the Prince Rule measurements are not currently required. The data of the naval aviation personnel reflect aging changes not atypical of the general population. Figure 1 graphically depicts accommodative powers for various ages for the Prince Rule normative population, for the standard Hofstetter formula (18.5 -.3age) (11), and for the right eye and left eye of the sample of the naval aviators.

Fusion-Related Variables

The current motility standard for naval aviators requires that there be no diplopia (double vision), no more than 10 prism diopters of esophoria/exophoria, and 100mm or less near-point convergence. The motility standards formerly included the requirement that the prism divergence for distance measurement equal or exceed the esophoria measurement and that candidates for aviation have at least 12 prism diopters of divergence for near.

Table V presents the data for the phorias, esophoria and exophoria; and the vergences, prism divergence at far and near, and nearpoint convergence. The data show the naval aviators in this sample were well within the prevailing standards and their motility remained intact throughout their service careers.

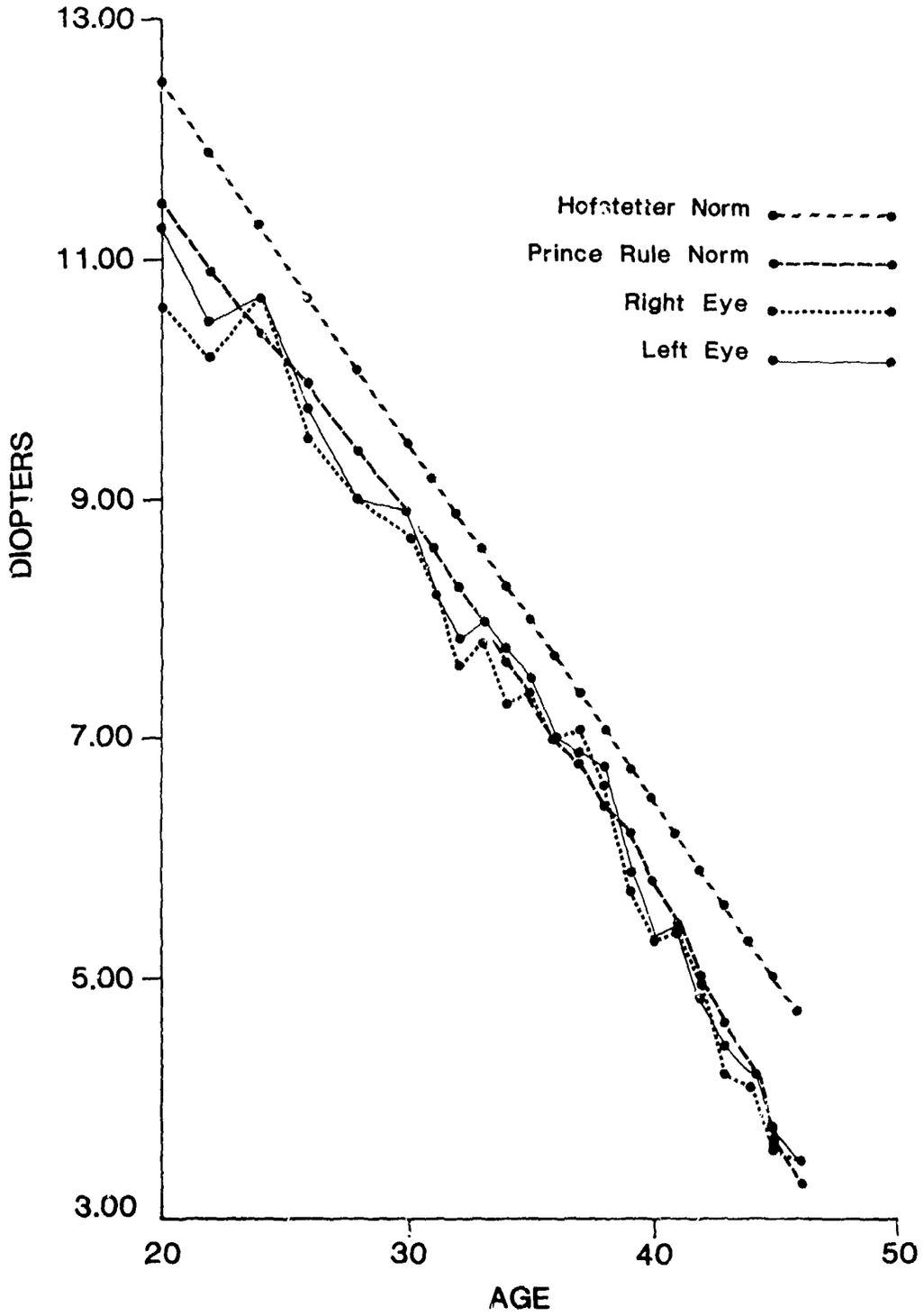

FIGURE 1- PRINCE RULE accomodation for the aviator sample compared to population norms at various ages.

Intraocular Pressure

Currently there are over one thousand pilots over the age of 40 in naval aviation (12). Since the typical occurence of glaucoma in populations over 40 years old is found to be at least 2 percent (13), the disease could be a potential aeromedical problem. A study of the 1970 incidence of glaucoma in Air Force pilots and navigators reported glaucoma or pre-glaucoma symptoms in less than one percent of the men 40 to 54 years old (14).

Intraocular pressure data for this study of 72 naval aviators are presented in Table VI. These data reflect normal measures throughout their service careers. These findings are exceptional and could be due to the routine health care and likelihood of early symptoms being detected and treated.

CONCLUSIONS AND RECOMMENDATIONS

This report presents normative data of visual characteristics of a sample of active duty and retired naval aviators. The data were collected from health records spanning the aviator's career--entrance physicals, annual flight physicals, and retirement physicals.

In summary, the findings are as follows:

- Distant visual acuity, near visual acuity, and accommodative amplitude decreased with age as expected.
- There was a trend toward increased myopia during operational flying years.
- Against-the-rule astigmatism increased with age as expected.
- Fusion-related variables remained stable throughout the naval aviator's career.
- Intraocular pressure was never clinically significant.

It is recommended that future research emphasize prediction capability, evaluation of standards, and development of training methodology. From identification of visual factors which change during the course of an aviator's career, efforts should be made to determine whether degredation can be predicted. The health record data should be examined for individual variability to determine rates of change of visual characteristics and individual differences as a function of age. Future studies should focus on an in-depth evaluation of current vision standards in relation to performance-based criteria. Adjustments in visual standards and the resulting impact of the standards in selection and retention should be determined. Development of training methodology is important to maintain and improve visual skills and assess the role of experience in compensating for visual degredation.

A wealth of data exists in the library of health records of naval aviators. Unfortunately, the data are not computerized. A computerized data bank of medical information among the naval aviation populations would be highly beneficial to the Navy. This aviation biomedical data bank would be of immeasurable value in; (1) validating current and future biomedical selection and retention standards; (2) serving as a data base for making medical dispositions in aviation personnel; (3) assist in developing a coherent waiver and medical review process; and (4) ensuring accurate record quality assurance and followups, just to name a few essential functions.

TABLE I

MEANS AND STANDARD DEVIATIONS OF SNELLEN FRACTION DENOMINATORS FOR DISTANT V

FOR RIGHT EYE AND LEFT EYE WITH AND WITHOUT CORRECTION BY

AGE	RIGHT EYE WITHOUT CORRECTION			LEFT EYE WITHOUT CORRECTION			RIGHT EYE WITH CORR	
	MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.
17.00	20.00	0.00	2	20.00	0.00	2	0.00	0.00
18.00	20.83	2.04	6	20.00	3.16	6	0.00	0.00
19.00	18.89	2.20	9	18.89	2.20	9	20.00	0.00
20.00	19.17	2.04	6	19.17	2.04	6	15.00	0.00
21.00	18.92	2.02	12	19.17	1.95	12	20.00	0.00
22.00	19.62	1.36	26	19.44	1.60	27	20.00	0.00
23.00	19.82	0.94	28	20.18	0.94	28	20.00	0.00
24.00	18.75	2.22	20	20.00	2.81	20	20.00	0.00
25.00	18.89	2.14	18	18.89	2.14	18	15.00	0.00
26.00	19.47	1.58	19	19.47	2.29	19	0.00	0.00
27.00	19.35	1.72	23	19.57	3.34	23	0.00	0.00
28.00	19.29	1.82	14	19.29	1.82	14	0.00	0.00
29.00	20.00	4.08	10	19.50	4.38	10	17.50	3.54
30.00	20.00	0.00	20	20.25	1.12	20	0.00	0.00
31.00	20.95	4.36	21	20.48	2.18	21	20.00	0.00
32.00	20.00	2.55	24	19.58	2.04	24	17.50	3.54
33.00	20.60	4.41	25	19.80	1.76	25	20.00	0.00
34.00	20.83	4.93	18	20.00	1.21	18	20.00	0.00
35.00	19.58	1.41	24	19.79	1.79	24	20.00	0.00
36.00	20.19	2.18	27	22.78	15.46	27	20.00	0.00
37.00	20.74	4.09	27	20.37	2.37	27	20.00	0.00
38.00	19.60	1.38	25	19.80	1.76	25	20.00	0.00
39.00	22.32	10.14	28	26.96	34.14	28	20.00	0.00
40.00	21.30	4.52	30	20.63	3.11	30	18.75	2.50
41.00	21.03	3.10	29	20.86	2.70	29	19.00	1.73
42.00	21.29	6.22	35	25.43	30.62	35	20.00	0.00
43.00	23.18	14.08	33	26.21	31.28	33	18.57	2.44
44.00	25.41	18.35	37	28.38	30.76	37	19.58	1.44
45.00	25.67	11.10	48	28.69	27.46	48	19.74	1.15
46.00	29.14	16.91	35	32.11	33.58	35	19.58	1.44
47.00	30.86	22.11	35	29.14	20.74	35	19.62	1.39
48.00	37.00	37.88	26	37.00	39.17	27	19.77	0.83
49.00	35.60	26.35	25	39.00	29.30	25	20.00	0.00
50.00	41.50	44.96	20	36.60	42.93	20	19.44	1.67
51.00	31.46	24.71	13	34.23	24.99	13	20.00	0.00
52.00	34.17	26.01	12	37.67	27.94	12	20.00	0.00
53.00	36.50	29.25	10	35.00	25.50	10	18.75	2.50
54.00	58.00	79.50	5	32.00	21.39	5	20.00	0.00
55.00	20.00	0.00	4	22.50	5.00	4	20.00	0.00
56.00	20.00	5.00	3	20.00	5.00	3	20.00	0.00
57.00	20.00	0.00	2	22.50	3.54	2	20.00	0.00
58.00	20.00	0.00	1	20.00	0.00	1	0.00	0.00
59.00	30.00	0.00	1	70.00	0.00	1	20.00	0.00
60.00	50.00	0.00	1	70.00	0.00	1	20.00	0.00
61.00	50.00	0.00	1	80.00	0.00	1	15.00	0.00
62.00	70.00	0.00	1	100.00	0.00	1	20.00	0.00

TABLE I

FRACTION DENOMINATORS FOR DISTANT VISION TESTED AT 20 FEET

EYE WITH AND WITHOUT CORRECTION BY AGE

T CORRECTION		RIGHT EYE WITH CORRECTION			LEFT EYE WITH CORRECTION		
.D.	N	MEAN	S.D.	N	MEAN	S.D.	N
.00	2	0.00	0.00	0	0.00	0.00	0
.16	6	0.00	0.00	0	0.00	0.00	0
.20	9	20.00	0.00	1	20.00	0.00	1
.04	6	15.00	0.00	1	15.00	0.00	1
.95	12	20.00	0.00	1	20.00	0.00	1
.60	27	20.00	0.00	1	20.00	0.00	1
.94	28	20.00	0.00	3	20.00	0.00	3
.81	20	20.00	0.00	1	20.00	0.00	1
.14	18	15.00	0.00	1	15.00	0.00	1
.29	19	0.00	0.00	0	20.00	0.00	1
.34	23	0.00	0.00	0	0.00	0.00	0
.82	14	0.00	0.00	0	0.00	0.00	0
.38	10	17.50	3.54	2	15.00	0.00	1
.12	20	0.00	0.00	0	20.00	0.00	1
.18	21	20.00	0.00	1	20.00	0.00	1
.04	24	17.50	3.54	2	20.00	0.00	1
.76	25	20.00	0.00	1	20.00	0.00	1
.71	18	20.00	0.00	1	20.00	0.00	1
.79	24	20.00	0.00	2	20.00	0.00	2
.46	27	20.00	0.00	1	20.00	0.00	1
.37	27	20.00	0.00	2	20.00	0.00	2
.76	25	20.00	0.00	1	20.00	0.00	1
.14	28	20.00	0.00	2	20.00	0.00	2
.11	30	18.75	2.50	4	18.75	2.50	4
.70	29	19.00	1.73	3	18.33	2.89	3
.22	35	20.00	0.00	3	18.33	2.89	3
.28	33	18.57	2.44	7	18.57	2.44	7
.76	37	19.58	1.44	12	19.17	1.95	12
.36	48	19.74	1.15	19	19.72	1.18	18
.58	35	19.58	1.44	12	19.58	1.44	12
.74	35	19.62	1.39	13	19.55	1.51	11
.17	27	19.77	0.83	13	19.77	0.83	13
.50	25	20.00	0.00	10	20.00	0.00	9
.23	20	19.44	1.67	9	19.38	1.77	8
.29	13	20.00	0.00	5	20.00	0.00	5
.74	12	20.00	0.00	6	20.00	0.00	6
.50	10	18.75	2.50	4	18.75	2.50	4
.19	5	20.00	0.00	3	20.00	0.00	3
.00	4	20.00	0.00	1	20.00	0.00	1
.00	3	20.00	0.00	1	20.00	0.00	1
.34	2	20.00	0.00	1	20.00	0.00	1
.00	1	0.00	0.00	0	0.00	0.00	0
.00	1	20.00	0.00	1	20.00	0.00	1
.00	1	20.00	0.00	1	20.00	0.00	1
.00	1	15.00	0.00	1	15.00	0.00	1
.00	1	20.00	0.00	1	20.00	0.00	1

MEANS AN

AGE	RIGHT EYE						
	Sphere (Diopters)			Cylinder (Diopters)			
	MEAN	S.D.	N	MEAN	S.D.	N	MEAN
17.00	0.00	0.00	0	0.00	0.00	0	0.00
18.00	0.00	0.00	0	0.00	0.00	0	0.00
19.00	0.50	1.41	2	0.50	0.00	1	15.00
20.00	1.00	0.00	1	0.00	0.00	0	0.00
21.00	0.17	0.14	3	-0.25	0.00	1	90.00
22.00	0.48	0.28	11	-0.10	0.22	5	61.25
23.00	0.60	0.34	5	-0.25	0.00	3	130.00
24.00	0.50	0.50	4	-0.25	0.00	1	90.00
25.00	0.50	0.79	5	-0.33	0.14	3	150.00
26.00	0.25	0.00	1	0.00	0.00	0	0.00
27.00	-0.13	0.18	2	-0.25	0.00	2	85.00
28.00	0.38	0.18	2	-0.50	0.00	1	137.50
29.00	-0.50	0.00	1	-0.25	0.00	1	100.00
30.00	0.75	0.00	1	-0.50	0.00	1	90.00
31.00	-1.00	0.00	1	0.25	0.00	1	70.00
32.00	0.67	0.95	3	-0.67	0.29	3	130.00
33.00	-0.75	0.00	1	0.00	0.00	0	0.00
34.00	-0.50	0.00	1	-0.25	0.00	1	90.00
35.00	0.50	0.00	1	0.00	0.00	0	0.00
36.00	-0.75	0.00	1	0.25	0.00	1	180.00
37.00	-0.25	0.25	3	-0.25	0.00	2	135.00
38.00	0.00	0.00	0	0.00	0.00	0	0.00
39.00	-0.42	0.80	3	-0.50	0.00	1	90.00
40.00	-0.20	0.89	5	0.25	0.75	3	91.67
41.00	-0.50	1.56	3	-0.17	0.38	3	65.00
42.00	0.88	0.53	2	-0.75	0.71	2	85.00
43.00	-0.04	0.95	7	-0.75	1.27	4	106.50
44.00	-0.40	1.06	13	0.16	0.52	11	127.27
45.00	-0.01	0.81	22	-0.28	0.63	18	103.71
46.00	-0.07	1.03	14	-0.25	0.73	10	95.50
47.00	-0.17	1.18	15	-0.23	0.99	12	101.00
48.00	0.16	1.00	14	-0.57	0.61	11	77.08
49.00	-0.73	1.39	10	-0.54	0.29	6	92.50
50.00	-0.94	1.70	9	-0.31	0.72	4	93.75
51.00	-0.63	1.37	6	-0.50	0.25	3	89.00
52.00	-0.35	1.38	5	-0.75	0.50	3	85.00
53.00	-0.05	1.84	5	-0.75	0.00	2	82.50
54.00	-0.75	1.75	3	-0.50	0.35	2	115.00
55.00	0.50	0.00	1	0.00	0.00	0	0.00
56.00	0.00	0.00	0	0.00	0.00	0	0.00
57.00	1.25	1.77	2	-0.75	0.00	1	115.00
58.00	0.00	0.00	0	0.00	0.00	0	0.00
59.00	1.00	0.00	1	0.00	0.00	0	0.00
60.00	1.50	0.00	1	0.00	0.00	0	0.00
61.00	1.50	0.00	1	0.00	0.00	0	0.00
62.00	1.50	0.00	1	0.00	0.00	0	0.00

TABLE II

MEANS AND STANDARD DEVIATIONS OF REFRACTIVE ERROR BY AGE

				LEFT EYE				
	Axis (Degrees)			Sphere (Diopters)			Cylinder (Diopters)	
N	MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.
0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
1	15.00	0.00	1	0.38	1.24	2	0.50	0.00
0	0.00	0.00	0	0.75	0.00	1	0.25	0.00
1	90.00	0.00	1	0.25	0.25	3	0.00	0.00
5	61.25	34.73	4	0.50	0.30	11	0.00	0.29
3	130.00	45.83	3	0.60	0.42	5	-0.33	0.14
1	90.00	0.00	1	0.00	0.29	4	-0.25	0.00
3	150.00	51.96	3	0.55	0.76	5	-0.31	0.13
0	0.00	0.00	0	0.00	0.00	1	0.00	0.00
2	85.00	98.99	2	-0.13	0.53	2	-0.38	0.18
1	137.50	45.96	2	0.50	0.00	1	-0.50	0.00
1	100.00	0.00	1	-0.25	0.00	1	-0.25	0.00
1	90.00	0.00	1	0.00	0.00	1	-0.50	0.00
1	70.00	0.00	1	-0.75	0.00	1	0.25	0.00
3	130.00	86.60	3	0.00	0.25	3	-0.38	0.18
0	0.00	0.00	0	-0.75	0.00	1	0.00	0.00
1	90.00	0.00	1	-0.25	0.00	1	-0.50	0.00
0	0.00	0.00	0	0.25	0.00	1	0.00	0.00
1	180.00	0.00	1	-0.75	0.00	1	0.25	0.00
2	135.00	63.64	2	0.00	0.35	2	-0.50	0.00
0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
1	90.00	0.00	1	-0.50	0.90	3	0.00	0.00
3	91.67	87.51	3	-0.15	0.96	5	0.17	0.88
3	65.00	52.20	3	-0.25	1.98	3	-0.25	0.43
2	85.00	21.21	2	0.88	1.24	2	-0.75	0.71
4	106.50	77.36	4	-0.04	1.04	6	-0.20	1.11
11	127.27	57.98	11	-0.48	1.30	11	0.34	0.78
18	103.71	41.61	17	-0.09	0.92	22	-0.08	0.66
10	95.30	62.84	10	0.04	1.11	12	-0.19	0.75
12	101.00	54.34	11	-0.08	1.11	15	-0.07	0.90
11	77.08	54.71	12	0.21	1.03	14	-0.43	0.55
6	92.50	56.28	6	-0.70	1.19	10	-0.50	0.20
4	93.75	7.46	4	-0.59	1.38	8	0.06	0.90
3	89.00	5.29	3	-0.67	1.14	6	-0.42	0.14
3	85.00	8.66	3	-0.20	1.07	5	-0.83	0.38
2	82.50	6.36	2	-0.15	1.56	5	-0.08	0.76
2	115.00	0.00	1	-0.25	0.50	3	-0.25	0.00
0	0.00	0.00	0	0.75	0.00	1	0.00	0.00
0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
1	115.00	0.00	1	0.00	0.00	1	0.00	0.00
0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
0	0.00	0.00	0	1.25	0.00	1	-0.25	0.00
0	0.00	0.00	0	1.75	0.00	1	-0.50	0.00
0	0.00	0.00	0	1.75	0.00	1	-0.50	0.00
0	0.00	0.00	0	2.00	0.00	1	-0.25	0.00

LEFT EYE						
	Cylinder (Diopters)			Axis (Degrees)		
N	MEAN	S.D.	N	MEAN	S.D.	N
0	0.00	0.00	0	0.00	0.00	0
0	0.00	0.00	0	0.00	0.00	0
2	0.50	0.00	1	155.00	0.00	1
1	0.25	0.00	1	180.00	0.00	1
3	0.00	0.00	0	0.00	0.00	0
11	0.00	0.29	4	81.25	34.73	4
5	-0.33	0.14	3	150.00	51.96	3
4	-0.25	0.00	2	115.00	35.36	2
5	-0.31	0.13	4	152.50	42.72	4
1	0.00	0.00	0	0.00	0.00	0
2	-0.38	0.18	2	159.00	1.41	2
1	-0.50	0.00	1	10.00	0.00	1
1	-0.25	0.00	1	70.00	0.00	1
1	-0.50	0.00	1	85.00	0.00	1
1	0.25	0.00	1	175.00	0.00	1
3	-0.38	0.18	2	180.00	0.00	2
1	0.00	0.00	0	0.00	0.00	0
1	-0.50	0.00	1	85.00	0.00	1
1	0.00	0.00	0	0.00	0.00	0
1	0.25	0.00	1	180.00	0.00	1
2	-0.50	0.00	1	85.00	0.00	1
0	0.00	0.00	0	0.00	0.00	0
3	0.00	0.00	0	0.00	0.00	0
5	0.17	0.88	3	136.67	45.09	3
3	-0.25	0.43	3	106.67	28.87	3
2	-0.75	0.71	2	101.00	29.70	2
6	-0.20	1.11	5	92.60	82.60	5
11	0.34	0.78	8	107.88	60.15	8
22	-0.08	0.66	16	105.73	39.71	15
12	-0.19	0.75	11	130.00	46.47	11
15	-0.07	0.90	11	109.90	53.24	10
14	-0.43	0.55	10	101.00	51.42	12
10	-0.50	0.20	4	103.75	37.72	4
8	0.06	0.90	4	69.75	36.89	4
6	-0.42	0.14	3	87.67	15.37	3
5	-0.83	0.38	3	91.67	12.58	3
5	-0.08	0.76	3	93.00	4.36	3
3	-0.25	0.00	2	67.50	31.82	2
1	0.00	0.00	0	0.00	0.00	0
0	0.00	0.00	0	0.00	0.00	0
1	0.00	0.00	0	0.00	0.00	0
0	0.00	0.00	0	0.00	0.00	0
1	-0.25	0.00	1	0.00	0.00	0
1	-0.50	0.00	1	90.00	0.00	1
1	-0.50	0.00	1	90.00	0.00	1
1	-0.25	0.00	1	94.00	0.00	1

MEANS AND STANDARD DEVI

AGE FOR F

AGE	WITHOUT CORRECTION						
	RIGHT EYE			LEFT EYE			
	MEAN	S.D.	N	MEAN	S.D.	N	MEAN
17.00	20.00	0.00	1	20.00	0.00	1	0.00
18.00	0.00	0.00	0	0.00	0.00	0	0.00
19.00	20.00	0.00	2	20.00	0.00	2	0.00
20.00	20.00	0.00	1	20.00	0.00	1	0.00
21.00	20.00	0.00	2	20.00	0.00	2	0.00
22.00	20.00	0.00	1	20.00	0.00	1	0.00
23.00	20.00	0.00	3	20.00	0.00	3	0.00
24.00	20.00	0.00	1	20.00	0.00	1	0.00
25.00	20.00	0.00	4	20.00	0.00	4	0.00
26.00	0.00	0.00	0	0.00	0.00	0	0.00
27.00	20.00	0.00	2	20.00	0.00	2	0.00
28.00	20.00	0.00	2	20.00	0.00	2	0.00
29.00	20.00	0.00	2	20.00	0.00	2	0.00
30.00	20.00	0.00	4	21.25	2.50	4	20.00
31.00	20.00	0.00	4	20.00	0.00	4	0.00
32.00	20.00	0.00	3	20.00	0.00	3	0.00
33.00	20.00	0.00	4	20.00	0.00	4	0.00
34.00	20.00	0.00	7	20.00	0.00	7	0.00
35.00	20.00	0.00	3	20.00	0.00	3	0.00
36.00	20.00	0.00	8	20.00	0.00	8	0.00
37.00	20.00	2.67	8	19.38	1.77	8	0.00
38.00	20.00	0.00	7	20.71	4.50	7	0.00
39.00	19.44	1.67	9	20.00	0.00	9	0.00
40.00	20.71	1.89	7	20.71	1.89	7	0.00
41.00	24.17	14.43	12	24.58	14.37	12	20.00
42.00	27.14	14.77	14	24.29	9.17	14	20.00
43.00	34.00	23.80	19	33.21	22.14	19	19.22
44.00	38.57	26.06	30	43.57	40.65	30	19.76
45.00	61.81	52.59	36	51.39	42.79	36	20.20
46.00	78.39	58.77	28	71.61	49.31	28	23.57
47.00	68.46	49.41	26	70.58	49.06	26	21.09
48.00	77.86	65.70	21	77.62	66.34	21	21.00
49.00	83.35	51.83	17	68.53	28.71	17	20.67
50.00	93.13	70.12	16	101.56	72.34	16	21.76
51.00	100.83	70.25	12	96.67	69.06	12	20.00
52.00	112.50	77.78	8	115.00	74.64	8	22.86
53.00	132.50	130.03	8	105.00	81.94	8	20.00
54.00	38.00	24.90	5	48.00	25.88	5	20.00
55.00	166.67	57.74	3	166.67	57.74	3	20.00
56.00	133.33	57.74	3	133.33	57.74	3	20.00
57.00	100.00	0.00	2	100.00	0.00	2	20.00
58.00	100.00	0.00	1	100.00	0.00	1	20.00
59.00	120.00	0.00	1	200.00	0.00	1	20.00
60.00	200.00	0.00	1	200.00	0.00	1	20.00
61.00	200.00	0.00	1	200.00	0.00	1	20.00
62.00	400.00	0.00	1	400.00	0.00	1	20.00

TABLE III

MEANS AND STANDARD DEVIATIONS OF SNELLEN FRACTION DENOMINATORS FOR NEAR VISUAL ACUITY BY AGE FOR RIGHT EYE AND LEFT EYE WITH AND WITHOUT CORRECTION

	WITH CORRECTION								
	RIGHT EYE			LEFT EYE			RIGHT EY		
N	MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D
1	0.00	0.00	0	0.00	0.00	0	0.00	0.
0	0.00	0.00	0	0.00	0.00	0	0.00	0.
2	0.00	0.00	0	0.00	0.00	0	0.00	0.
1	0.00	0.00	0	0.00	0.00	0	0.00	0.
2	0.00	0.00	0	0.00	0.00	0	0.00	0.
1	0.00	0.00	0	0.00	0.00	0	0.00	0.
3	0.00	0.00	0	0.00	0.00	0	0.00	0.
1	0.00	0.00	0	0.00	0.00	0	0.00	0.
4	0.00	0.00	0	0.00	0.00	0	0.00	0.
0	0.00	0.00	0	0.00	0.00	0	0.00	0.
2	0.00	0.00	0	0.00	0.00	0	0.00	0.
2	0.00	0.00	0	0.00	0.00	0	0.00	0.
2	0.00	0.00	0	0.00	0.00	0	0.00	0.
4	20.00	0.00	1	20.00	0.00	1	0.00	0.
4	0.00	0.00	0	0.00	0.00	0	0.00	0.
3	0.00	0.00	0	0.00	0.00	0	0.00	0.
4	0.00	0.00	0	0.00	0.00	0	0.00	0.
7	0.00	0.00	0	0.00	0.00	0	0.00	0.
3	0.00	0.00	0	0.00	0.00	0	0.00	0.
8	0.00	0.00	0	0.00	0.00	0	0.00	0.
8	0.00	0.00	0	0.00	0.00	0	0.00	0.
7	0.00	0.00	0	0.00	0.00	0	0.00	0.
9	0.00	0.00	0	0.00	0.00	0	0.00	0.
7	0.00	0.00	0	0.00	0.00	0	1.00	0.
12	20.00	0.00	1	20.00	0.00	2	0.00	0.
14	20.00	0.00	5	20.00	0.00	5	1.00	0.
19	19.22	2.33	9	19.22	2.33	9	1.04	0.
30	19.76	0.97	17	19.75	1.00	16	1.22	0.
36	20.20	1.00	25	21.20	6.00	25	1.41	0.
28	23.57	7.93	21	22.38	5.15	21	1.40	0.
26	21.09	4.25	23	20.22	1.04	23	1.45	0.
21	21.00	4.95	17	20.12	1.45	17	1.32	0.
17	20.67	1.76	15	20.67	2.58	15	1.50	0.
16	21.76	7.28	17	25.00	20.00	16	1.81	0.
12	20.00	0.00	8	20.00	0.00	8	1.78	0.
8	22.86	7.56	7	21.43	3.78	7	1.79	0.
8	20.00	0.00	7	20.00	0.00	7	2.00	0.
5	20.00	0.00	4	21.25	2.50	4	2.08	0.
3	20.00	0.00	2	20.00	0.00	2	2.38	0.
3	20.00	0.00	3	20.00	0.00	3	1.88	0.
2	20.00	0.00	2	20.00	0.00	2	2.50	0.
1	20.00	0.00	1	20.00	0.00	1	0.00	0.
1	20.00	0.00	1	20.00	0.00	1	2.50	0.
1	20.00	0.00	1	20.00	0.00	1	2.00	0.
1	20.00	0.00	1	20.00	0.00	1	2.00	0.
1	20.00	0.00	1	20.00	0.00	1	1.50	0.

FOR NEAR VISUAL ACUITY BY

RRECTION

		ADD					
YE		RIGHT EYE			LEFT EYE		
D.	N	MEAN	S.D.	N	MEAN	S.D.	N
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	1	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	0.00	0.00	0	0.00	0.00	0
.00	0	1.00	0.00	1	1.00	0.00	1
.00	2	0.00	0.00	0	0.00	0.00	0
.00	5	1.00	0.35	2	1.33	0.63	3
.33	9	1.04	0.27	7	1.08	0.30	6
.00	16	1.22	0.31	8	1.31	0.37	8
.00	25	1.41	0.34	17	1.37	0.35	17
.15	21	1.40	0.38	10	1.35	0.39	10
.04	23	1.45	0.44	15	1.45	0.46	15
.45	17	1.32	0.36	11	1.59	0.39	11
.58	15	1.50	0.43	13	1.52	0.44	13
.00	16	1.81	0.47	13	1.75	0.41	13
.00	8	1.78	0.31	8	1.81	0.35	8
.78	7	1.79	0.51	6	1.79	0.51	6
.00	7	2.00	0.45	6	2.00	0.45	6
.50	4	2.08	0.14	3	2.08	0.14	3
.00	2	2.38	0.18	2	2.25	0.00	2
.00	3	1.88	0.18	2	1.88	0.18	2
.00	2	2.50	0.00	1	2.38	0.18	2
.00	1	0.00	0.00	0	0.00	0.00	0
.00	1	2.50	0.00	1	2.50	0.00	1
.00	1	2.00	0.00	1	2.00	0.00	1
.00	1	2.00	0.00	1	2.00	0.00	1
.00	1	1.50	0.00	1	1.50	0.00	1

TABLE IV

ACCOMMODATION MEANS AND STANDARD DEVIATIONS BY AGE

AGE	RIGHT EYE (Diopters)			LEFT EYE (Diopters)		
	MEAN	S.D.	N	MEAN	S.D.	N
17.00	0.00	0.00	0	0.00	0.00	0
18.00	11.50	0.00	1	10.90	0.00	1
19.00	12.50	0.85	2	12.30	1.13	2
20.00	10.37	0.58	3	11.27	0.28	3
21.00	10.36	1.39	11	10.45	1.39	11
22.00	10.20	1.42	27	10.49	1.44	27
23.00	10.05	1.34	26	10.19	1.39	26
24.00	10.66	1.57	20	10.71	1.42	19
25.00	9.67	1.70	18	9.62	1.56	18
26.00	9.43	1.78	19	9.81	1.58	19
27.00	9.14	1.05	23	9.47	1.12	23
28.00	8.98	1.47	12	9.03	1.43	12
29.00	9.71	1.36	9	8.87	1.17	9
30.00	8.72	1.20	19	8.87	1.25	19
31.00	8.20	1.73	20	8.32	1.66	20
32.00	7.60	1.28	23	7.83	1.16	23
33.00	7.83	1.59	23	7.97	1.47	23
34.00	7.31	1.46	14	7.74	1.51	14
35.00	7.37	1.13	23	7.53	1.10	23
36.00	6.94	0.81	26	7.03	1.06	26
37.00	7.05	1.67	22	6.93	1.52	22
38.00	6.58	1.55	22	6.74	1.59	21
39.00	5.67	1.13	21	5.85	1.18	21
40.00	5.27	1.32	26	5.27	1.25	26
41.00	5.34	1.16	23	5.41	1.27	23
42.00	4.94	1.59	21	4.85	1.52	21
43.00	4.12	0.86	20	4.41	1.11	20
44.00	4.12	1.26	18	4.22	1.31	18
45.00	3.55	1.24	19	3.76	1.38	19
46.00	3.45	1.68	12	3.48	1.56	12
47.00	2.93	1.13	16	3.62	3.32	17
48.00	3.20	0.94	8	3.04	0.74	8
49.00	2.89	0.91	8	2.51	0.45	8
50.00	2.10	0.22	5	2.10	0.22	5
51.00	4.00	3.46	3	4.00	3.46	3
52.00	2.38	0.63	6	2.42	0.71	6
53.00	2.50	0.61	5	2.47	0.54	5
54.00	3.70	2.40	2	3.30	1.84	2
55.00	0.00	0.00	0	0.00	0.00	0
56.00	0.00	0.00	0	0.00	0.00	0
57.00	0.00	0.00	0	0.00	0.00	0
58.00	0.00	0.00	0	0.00	0.00	0
59.00	0.00	0.00	0	0.00	0.00	0
60.00	0.00	0.00	0	0.00	0.00	0
61.00	0.00	0.00	0	0.00	0.00	0
62.00	0.00	0.00	0	0.00	0.00	0

TABLE V

MEANS AND STANDARD DEVIATIONS OF FUSIO

AGE	ESOPHORIA (Prism Diopters)			EXOPHORIA (Prism Diopters)			NEAR PI (P
	MEAN	S.D.	N	MEAN	S.D.	N	MEAN
17.00	0.00	0.00	0	0.00	0.00	0	0.00
18.00	2.50	2.12	2	0.00	0.00	2	22.00
19.00	1.00	1.00	3	0.33	0.58	3	28.00
20.00	1.50	1.73	4	0.00	0.00	4	18.00
21.00	1.40	1.65	10	0.10	0.32	10	16.75
22.00	0.65	1.02	26	0.23	0.65	26	19.42
23.00	0.84	1.18	25	0.20	0.50	25	19.00
24.00	0.50	0.89	20	0.37	0.68	19	18.47
25.00	1.22	1.22	18	0.78	1.26	18	18.24
26.00	0.28	0.67	18	0.22	0.65	18	20.44
27.00	1.22	1.54	23	0.17	0.58	23	20.09
28.00	0.69	1.32	13	0.08	0.28	13	20.73
29.00	1.10	1.29	10	0.40	0.84	10	18.67
30.00	1.00	1.08	20	0.25	0.55	20	21.84
31.00	0.52	1.03	21	0.55	1.19	20	19.63
32.00	1.14	1.49	22	0.25	0.68	24	21.57
33.00	0.96	1.16	24	0.35	0.81	24	19.28
34.00	0.88	1.45	17	0.72	1.60	18	19.27
35.00	0.88	1.33	24	0.48	1.27	23	18.73
36.00	0.85	0.97	26	0.48	1.17	26	18.15
37.00	0.78	1.16	25	0.32	0.63	25	19.00
38.00	0.89	1.07	23	0.21	0.72	24	22.38
39.00	1.25	1.27	28	0.00	0.00	27	20.50
40.00	0.95	1.11	31	0.16	0.37	31	20.38
41.00	1.38	1.44	26	0.37	1.39	27	14.60
42.00	1.13	1.31	32	0.19	0.47	32	20.07
43.00	0.84	1.48	32	0.29	0.78	31	20.08
44.00	0.97	1.16	36	0.33	0.89	36	21.08
45.00	1.39	1.51	41	0.24	0.58	41	20.89
46.00	1.84	2.03	31	0.16	0.58	31	21.14
47.00	1.12	1.39	34	0.18	0.58	33	20.17
48.00	1.38	1.82	21	0.23	0.53	23	22.00
49.00	1.62	1.50	21	0.19	0.40	21	21.00
50.00	1.71	2.49	14	0.46	0.88	13	0.00
51.00	0.71	0.95	7	0.17	0.41	6	0.00
52.00	1.71	0.49	7	0.00	0.00	8	22.33
53.00	1.38	2.20	8	0.44	0.90	8	16.00
54.00	1.00	1.41	2	1.25	1.77	2	18.00
55.00	1.00	1.00	3	0.83	1.44	3	0.00
56.00	0.50	0.71	2	0.00	0.00	2	0.00
57.00	0.00	0.00	1	0.00	0.00	1	0.00
58.00	0.00	0.00	1	0.00	0.00	1	0.00
59.00	2.00	0.00	1	0.00	0.00	1	0.00
60.00	3.00	0.00	1	0.00	0.00	0	0.00
61.00	3.00	0.00	1	0.00	0.00	0	0.00
62.00	6.00	0.00	1	0.00	0.00	1	0.00

TABLE V

ND STANDARD DEVIATIONS OF FUSION · RELATED VARIABLES BY AGE

HORIA (Diopters)		NEAR PRISM DIVERGENCE (Prism Diopters)			FAR PRISM DIVERGENCE (Prism Diopters)			PRISM C (M
S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	MEAN
0.00	0	0.00	0.00	0	0.00	0.00	0	0.00
0.00	2	22.00	0.00	1	6.00	0.00	1	31.00
0.58	3	28.00	0.00	1	7.00	0.00	1	39.50
0.00	4	18.00	5.66	2	6.00	2.83	2	21.67
0.32	10	16.75	5.52	8	6.00	3.74	6	33.91
0.65	26	19.42	4.09	24	6.53	2.29	15	29.04
0.50	25	19.00	3.72	25	5.44	1.72	18	28.77
0.68	19	18.47	3.73	19	9.08	10.65	13	37.50
1.26	18	18.24	7.23	17	6.23	2.05	13	32.61
0.65	18	20.44	4.33	18	6.11	1.69	9	29.79
0.58	23	20.09	5.32	22	6.31	2.12	16	23.82
0.28	13	20.73	5.14	11	6.60	2.41	10	28.31
0.84	10	18.67	3.71	9	5.50	1.38	6	33.11
0.55	20	21.84	4.97	19	5.33	2.09	15	31.25
1.19	20	19.63	3.61	19	6.25	3.70	12	27.05
0.68	24	21.57	4.51	21	5.89	2.19	18	31.86
0.81	24	19.28	5.46	18	6.11	3.27	18	26.23
1.60	18	19.27	4.50	11	5.78	2.11	9	28.33
1.27	23	18.73	6.26	15	6.82	2.75	11	25.70
1.17	26	18.15	2.97	13	5.09	1.70	11	26.76
0.63	25	19.00	3.90	14	6.38	3.64	13	27.43
0.72	24	22.38	4.54	13	6.77	3.35	13	27.47
0.00	27	20.50	5.27	12	6.10	3.73	10	28.54
0.37	31	20.38	5.22	13	5.83	1.34	12	27.37
1.39	27	14.60	6.48	10	4.57	1.13	7	28.86
0.47	32	20.07	5.03	14	5.36	1.03	11	25.81
0.78	31	20.08	6.53	12	7.30	3.85	10	24.23
0.89	36	21.08	5.71	13	6.17	1.70	12	32.65
0.58	41	20.89	6.27	9	5.22	1.39	9	32.41
0.58	31	21.14	5.18	7	6.00	1.20	8	34.83
0.58	33	20.17	3.82	6	6.00	1.67	6	28.77
0.53	22	22.00	2.83	2	5.00	1.41	2	27.67
0.40	21	21.00	7.02	4	6.00	2.16	4	30.44
0.88	13	0.00	0.00	0	0.00	0.00	0	25.00
0.41	6	0.00	0.00	0	0.00	0.00	0	49.75
0.00	8	22.33	1.53	3	6.67	2.89	3	39.17
0.90	8	16.00	0.00	1	3.00	1.41	2	39.00
1.77	2	18.00	0.00	1	4.00	0.00	1	60.00
1.44	3	0.00	0.00	0	0.00	0.00	0	60.00
0.00	2	0.00	0.00	0	0.00	0.00	0	53.00
0.00	1	0.00	0.00	0	0.00	0.00	0	0.00
0.00	1	0.00	0.00	0	0.00	0.00	0	0.00
0.00	1	0.00	0.00	0	0.00	0.00	0	69.00
0.00	0	0.00	0.00	0	0.00	0.00	0	35.00
0.00	0	0.00	0.00	0	0.00	0.00	0	0.00
0.00	1	0.00	0.00	0	0.00	0.00	0	0.00

GE

FAR PRISM DIVERGENCE (Prism Diopters)			PRISM CONVERGENCE (Millimeters)		
EAN	S.D.	N	MEAN	S.D.	N
.00	0.00	0	0.00	0.00	0
.00	0.00	1	31.00	9.90	2
.00	0.00	1	39.50	0.71	2
.00	2.83	2	21.67	20.21	3
.00	3.74	6	33.91	17.27	11
.53	2.29	15	29.04	13.53	26
.44	1.72	18	28.77	15.31	26
.08	10.65	13	37.50	20.78	20
.23	2.05	13	32.61	19.01	18
.11	1.69	9	29.79	14.88	19
.31	2.12	16	23.82	9.73	22
.60	2.41	10	28.31	13.01	13
.50	1.38	6	33.11	12.47	9
.33	2.09	15	31.25	12.01	20
.25	3.70	12	27.05	10.37	19
.89	2.19	18	31.86	14.05	22
.11	3.27	18	26.23	10.01	22
.78	2.11	9	28.33	11.22	15
.82	2.75	11	25.70	13.23	20
.09	1.70	11	26.76	13.16	21
.38	3.64	13	27.43	10.44	23
.77	3.35	13	27.47	11.56	19
.10	3.73	10	28.54	15.54	24
.83	1.34	12	27.37	13.84	27
.57	1.13	7	28.86	18.18	22
.36	1.03	11	25.81	13.33	24
.30	6.85	10	24.23	10.57	22
.17	1.75	12	32.65	14.79	20
.22	1.39	9	32.41	22.64	22
.00	1.20	8	34.83	20.92	18
.00	1.67	6	28.77	21.57	22
.00	1.41	2	27.67	13.90	9
.00	2.16	4	30.44	11.42	9
.00	0.00	0	25.00	12.26	6
.00	0.00	0	49.75	13.82	4
.67	2.89	3	39.17	25.58	6
.00	1.41	2	39.00	13.42	5
.00	0.00	1	60.00	0.00	1
.00	0.00	0	60.00	0.00	1
.00	0.00	0	53.00	9.90	2
.00	0.00	0	0.00	0.00	0
.00	0.00	0	0.00	0.00	0
.00	0.00	0	69.00	0.00	1
.00	0.00	0	35.00	0.00	1
.00	0.00	0	0.00	0.00	0
.00	0.00	0	0.00	0.00	0

TABLE VI

INTRAOCULAR TENSION MEANS AND STANDARD DEVIATIONS BY AGE

Millimeters of Mercury

AGE	RIGHT EYE			LEFT EYE		
	MEAN	S.D.	N	MEAN	S.D.	N
17.00	0.00	0.00	0	0.00	0.00	0
18.00	0.00	0.00	0	0.00	0.00	0
19.00	0.00	0.00	0	0.00	0.00	0
20.00	0.00	0.00	0	0.00	0.00	0
21.00	9.00	0.00	1	9.00	0.00	1
22.00	0.00	0.00	0	0.00	0.00	0
23.00	0.00	0.00	0	0.00	0.00	0
24.00	0.00	0.00	0	0.00	0.00	0
25.00	0.00	0.00	0	0.00	0.00	0
26.00	0.00	0.00	0	0.00	0.00	0
27.00	0.00	0.00	0	0.00	0.00	0
28.00	0.00	0.00	0	0.00	0.00	0
29.00	0.00	0.00	0	0.00	0.00	0
30.00	15.90	0.00	1	14.60	0.00	1
31.00	20.10	0.00	1	14.20	0.00	1
32.00	19.55	1.48	2	20.25	2.47	2
33.00	17.30	0.00	1	17.30	0.00	1
34.00	20.10	0.00	1	18.50	0.00	1
35.00	14.39	4.84	7	17.84	3.06	5
36.00	15.25	3.92	13	15.48	4.22	12
37.00	15.68	1.96	8	15.60	2.02	8
38.00	15.40	2.10	12	14.95	2.37	12
39.00	17.01	2.27	16	17.50	2.60	14
40.00	17.03	4.34	20	16.21	4.28	18
41.00	16.43	2.88	26	16.74	3.15	25
42.00	16.84	2.84	22	16.24	3.18	19
43.00	17.72	2.12	26	17.88	2.35	26
44.00	15.86	3.02	31	15.69	3.09	30
45.00	16.38	2.84	36	16.10	2.99	33
46.00	16.07	3.18	30	16.21	4.03	29
47.00	16.07	2.39	31	15.98	2.82	27
48.00	16.48	4.90	21	16.15	4.86	21
49.00	15.85	2.32	23	15.44	2.26	21
50.00	15.04	2.67	18	15.01	3.33	17
51.00	14.25	3.73	13	13.86	3.73	13
52.00	16.79	3.54	10	16.94	3.22	10
53.00	16.11	3.54	10	15.58	2.21	10
54.00	16.86	4.27	5	16.06	2.68	5
55.00	17.55	2.30	4	16.73	1.15	4
56.00	16.15	1.63	2	16.15	1.63	2
57.00	14.00	1.41	2	14.00	1.41	2
58.00	16.00	0.00	1	17.00	0.00	1
59.00	15.00	0.00	1	15.00	0.00	1
60.00	12.00	0.00	1	11.00	0.00	1
61.00	10.00	0.00	1	11.00	0.00	1
62.00	13.00	0.00	1	13.00	0.00	1

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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Visual Characteristics; Age; Naval Aviation

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Failure to meet required visual standards provides a significant source of rejections to naval aviation training and of disqualifications of designated aviators for Service Group I. It is important to assure these standards represent the visual abilities which are critical to mission performance, and to assure their proper application throughout the aviator's career. The purpose of this report is to assess the visual characteristics of stratified samples (active duty/retired) within the naval aviation community through the

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examination of health records, to determine the distribution of those characteristics, and to identify those characteristics that have been noted to change during the course of the naval aviator's career. The findings, based on an examination of 72 health records, show that with increasing age there are decreases in visual acuity and accommodative amplitude, increases in against-the-rule astigmatism and myopia, and stability in fusion-related variables and intraocular pressure.

Baisden, A. G.
Monaco, W. A.
NAMRL-1301
DISTRIBUTION OF VISUAL CHARACTERISTICS OF NAVAL AVIATION PERSONNEL. Pensacola, FL: Naval Aerospace Medical Research Laboratory,

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Visual Characteristics

Age

Naval Aviation

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Visual Characteristics

Age

Naval Aviation