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The correlation between refractive error and pupil size

Abstract

The existence of a relationship between pupil size and refractive error among school-aged children was investigated in the present study. Pupil size was recorded photographically, and refractive error was determined by retinoscopy. In general, the subjects represented two age groups: ages 6-7 and ages 14-15. The results found that both age groups showed negative correlations between pupil size and refractive error; however, not all correlations were statistically significant. More correlations were statistically significant in the female age 6-7 group than in the male age 6-7 group, while more correlations were statistically significant in the male age 14-15 group than in the female age 14-15 group. When all subjects, male and female ages 6-15, were analyzed, a significant (p

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Steven L. Beedle

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THE CORRELATION BETWEEN
REFRACTIVE ERROR AND PUPIL SIZE

Joseph W Glandon

Advisors: Steven L. Beedle, Ph.D.
Francis A. Young, Ph.D.

Pacific University College of Optometry

February 9, 1979

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Many thanks to Alan Colson for his help with the computer analysis of the data.

THE CORRELATION OF PUPIL SIZE
WITH REFRACTIVE ERROR

ABSTRACT

The existence of a relationship between pupil size and refractive error among school-aged children was investigated in the present study. Pupil size was recorded photographically, and refractive error was determined by retinoscopy. In general, the subjects represented two age groups: ages 6-7 and ages 14-15. The results found that both age groups showed negative correlations between pupil size and refractive error; however, not all correlations were statistically significant. More correlations were statistically significant in the female age 6-7 group than in the male age 6-7 group, while more correlations were statistically significant in the male age 14-15 group than in the female age 14-15 group. When all subjects, male and female ages 6-15, were analyzed, a significant ($p < .01$) negative correlation was found between refractive error and pupil size with both right and left eyes. The results of this study indicated that, in general, myopes had a larger pupil diameter than did hypermetropes, this trend becoming stronger among older children.

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INTRODUCTION

Practitioners often state that myopes have bigger pupils than non-myopes, but few studies have been concerned with determining a correlation between pupil size and refractive error. Goodrich (1974) in his thesis found no correlation between refractive error and pupil size; however, this finding is contrary to three available published works:

- Silberkuhle (1896) found a larger diameter pupil size in myopes than non-myopes, but only in subjects over 20 years of age.
- Tange (1903) found a larger pupil size in myopes than in non-myopes.
- Hirsch and Weymouth (1949) found a greater pupil size in myopes than in non-myopes, but utilized a target at 50 cm; thus their results to some degree may have reflected the difference in accommodation for the target by myopes and hypermetropes.

The subjects in Goodrich's study were university students with a mean refraction of -1.43D.

The fact that mental activity will cause dilation of the pupil has been documented by a number of researchers (e.g., Kahneman and Beatty, 1966; Kahneman, Onuska and Wolman, 1969; Goldwater, 1972; Shiffman, 1976). Hess (1975) reported that pupil size of persons engaged in mental arithmetic increased as much as 29.5%. The mean increase in pupil size for simple computations such as 7x8 was 10.8%, while more difficult computations such

as 16x23 resulted in a mean increase of pupil size of 21.6%. This finding leads to the possibility that individuals whose mental activity is at a relatively high level will have a tonic pupil size which is larger than pupils of individuals who function at a lower level of mental activity.

The large pupil whose depth of focus is smaller than that of the small pupil will contribute to a greater accommodative demand on large-pupil individuals at near (Borish, 1970). Thus the mentally active, achieving individual that spends much of his time at near involves himself with prolonged states of accommodation because of his near-point environment. The accommodative demand is further increased by a loss of depth of focus associated with larger pupils. According to the environmental theory of myopia (Oakley and Young, 1975), these individuals whose personality characteristics bring them to spend much time at near are prime candidates for the development of myopia.

Beedle and Young (1976) and Young (1975) have found that personality characteristics of myopes were consistently different from those of non-myopes. Here myopes were found to be more anxious and more likely to be introverted in their personality characteristics, and in general were more educated and greater achievers than non-myopes. From the above results, it may be argued that myopes will demonstrate a greater level of mental activity and hence the average pupil size of myopes will be larger than the average pupil size of non-myopes.

The purpose, then, of this project is to determine if this projected relationship holds, that is, the pupil size of myopes is larger than those of non-myopes. In addition, research emphasis in the present study will be directed toward those individuals under 18 years of age in order to involve

the age group that shows the earlier stages of progression into myopia. Finally, the utilization of subjects from grade and high school screening programs will result in findings that are more representative of the general population.

METHOD

Subjects

The subjects were obtained from two visual screening programs sponsored by Pacific University College of Optometry. The first screening program was at the Myrtle Point school district where approximately 300 subjects were obtained. The second visual screening program was in the area of the Gold Beach school district. Here 471 subjects were obtained. The present study incorporated only the information from the second screening. The first screening was classified as a pilot program, with an emphasis on establishing an experimental technique which would reduce experimental error on the second screening.

Of the 471 subjects, only 390 had complete sets of data. Only these subjects' data were considered for analysis. Of these 390 subjects, 183 were female and 207 were male. Ages of the subjects ranged from 6 to 16 years. Two subjects were age 16; their data were included in the 15-year age group data. Five of the subjects were non-caucasian.

Data from both eyes of each subject was taken, and right eyes were analyzed separately from the left eyes. Three hundred eighty one eyes were in the hypermetropic range ($+0.370$ or greater), 208 eyes were emmetropic ($+0.25$ to $-0.12D$), and 191 eyes were in the myopic range (-0.25 or greater). Refractive error was converted to spherical equivalents. The distribution of the degree of refractive error by subject age and sex is given in Table 1.

Insert Table 1 here

Apparatus

The apparatus used for photographing the pupil consisted of a 35mm single lens reflex camera equipped with a 135mm telephoto lens, 122mm of extension tubes and an electronic flash. This arrangement resulted in a negative size:actual size ratio of approximately 1:1. Illumination was fixed at a moderate level, with the pupil being illuminated by a $7\frac{1}{2}$ watt bulb positioned approximately 18" in front of the subject and 30 degrees below the subject's line of sight. An adjustable stand for the light source was utilized. To assure constancy of illumination from subject to subject, an $8\frac{1}{2}$ by 11 white test paper was held at the plane of the subject's eyes and its illuminance was checked by using a light meter which was held 18" from the test paper. (The light level was such that 100 ASA film at a shutter speed of 1/30 second indicated a $f\frac{1}{4}$ f-stop setting when the light meter was directed at the test paper.) The test paper was secured to a clip-board which was held at the plane of the subject's face. The light meter was secured to a string which was attached to the clip-board; this method assured that the distance from the light meter to the test paper remained constant between readings.

A measuring reticule calibrated in .01" markings was used. In addition to being the measure used as the standard for calculating pupil size, it also included an identifying number. Here a small piece of opaque white plastic tape was secured to one end of the reticule. A water-soluble felt-tipped pen was used to mark the subject number on the tape. Between subject testing sessions, the ink was wiped off and the new subject number was added. Experience indicated that the best position for the reticule to be held was vertically at the top of the lower lid below the pupil. When held horizontally, there was a greater tendency for the reticule to be tilted to the side.

Procedure

The subject's right eye was photographed first. The camera was positioned directly along the eye's line of sight while the left eye fixated a snellen chart at 20 feet. This same procedure was repeated with the left eye. The identifying number on the reticule was marked on a 3x5 inch card on which the subject's name, age, race and sex was included. This 3x5 inch card was then stapled to the subject's screening form. Next, the subject proceeded to the retinoscopy section where senior optometry interns refracted the subject and marked the refraction on the 3x5 inch card.

The negatives, after being developed, were then projected using a film strip projector. The meridian which resulted in the largest pupil diameter was used to measure pupil size. Pupil:iris ratio was also recorded in the horizontal meridian. The distance between two points on the reticule was also measured. Pupil size (largest diameter), iris size (horizontal diameter) and pupil:iris ratio were then calculated for each eye.

The study was conducted in a double-blind manner. Subjects' eyes were photographed prior to retinoscopy so refractive error was not known; the retinoscopy was performed and recorded by optometry clinicians not involved with the thesis project. Pupil and iris parameters were later recorded from projected negatives without knowledge of refractive errors.

RESULTS

Measurements of nine variables were obtained from each subject. The first two variables were refractive error, right and left eye. The next two variables were pupil diameter, right and left eye. Variables 5 and 6 were pupil:iris ratio of the horizontal meridian, right and left eye; variables 7 and 8 were iris diameter, right and left eye; and the last variable was the subject's age. For purpose of analysis, the data were grouped into the following sex and age groups:

Females: age 6; 7; 6-7; 8-13; 14; 15; 14-15; 6-15

Males: age 6; 7; 6-7; 8-13; 14; 15; 14-15; 6-15

Males and females: age 6; 7; 6-7; 8-13; 14; 15; 14-15; 6-15

There were enough subjects in each of the age groups 6, 7, 14 and 15 to analyze these data separately. Only 20 subjects age 8-13 were in the data, therefore these data were analyzed together. Age groups 6 and 7 were then combined and the data analyzed as a single group. A similar technique was done for groups age 14 and 15. Data for males and females were each analyzed separately in this fashion. Both male and female data were then combined into one group and analyzed in the same manner.

Data analysis consisted of calculating the correlation coefficients between refractive error and pupil size, pupil:iris ratio and age for each age group using a multi-variant correlation computer program. Right eye data were maintained separate from left eye data. This procedure served the purpose of having parallel sets of data which could be compared with one another. The means and standard deviations for each variable per age

group were also determined. These results are presented in the following tables:

- Tables 2, 3 and 4 contain correlation coefficients between refractive error, pupil size and pupil:iris ratio for males, females, and combined males and females.
- Tables 5, 6 and 7 list the coefficient of determination for those values in Tables 2, 3 and 4 that were significant at the .05 or .01 level.
- Tables 8, 9 and 10 present the mean and standard deviation values for pupil size and pupil:iris ratio for all age groups.
- Tables 11, 12 and 13 list the mean and standard deviation values for refractive error and iris diameter for all groups.
- Table 14 summarizes the correlations between each variable for all subjects.
- Table 15 summarizes the correlations between each variable for all females.
- Table 16 summarizes the correlations between each variable for all males.

Insert Tables 2 through 16 here

The computer print-out results of means, standard deviations and correlation coefficients for all groups are included in the appendix.

In general, when analyzed for correlations between refractive error (right and left eyes) and pupil size or pupil:iris ratio:

- Females analyzed in individual age groups showed few significant correlations.

Females analyzed as a single group showed significant correlations on all 4 variables.

Males analyzed in individual groups showed no significant correlations at the younger age groups, but the older age groups showed many significant correlations.

Males analyzed as a single group showed significant correlations on all variables.

Males and females analyzed together showed even more significant correlations; the highest significant correlations were again among the older age groups.

When all ages were combined, the highest significant correlations were obtained. It is recognized, however, that the statistical significance levels in correlation are affected by sample size.

Of interest was a difference in the mean pupil size and iris diameter between the right and left eyes. The mean right pupil size for all subjects was .3mm greater than the left eye; the mean right iris diameter for all subjects was .4mm greater than the mean left iris diameter. These findings were consistent for both sexes at all age groups. Refractive error showed a significant negative correlation with age -- that is, older subjects were more myopic. Pupil size and pupil:iris ratio in general did not significantly correlate with age in this study. Iris diameter and age showed a significant negative correlation; older subjects had smaller iris diameters by about .1 to .2mm.

As previously mentioned, Tables 5, 6 and 7 present the coefficient of determination for significant correlations between refractive error and pupil diameter or pupil:iris ratio. Multiply these figures by 100, and the resulting value is the percent of variability accounted for in one

variable by a change in the second variable. For total females, the value was about 3%; for males, about 4%; and for all subjects, about 3.4%. The highest coefficient of determination was for males, age 15; about 22%.

DISCUSSION

The results of this study suggest there is a significant negative correlation between pupil size and refractive error, and that this correlation becomes stronger as age increases. Males in general showed a greater correlation coefficient value than did females. The significance of the correlation value became greater when all age groups were included in the statistical analysis for males and females, respectively. The significance of the correlation also increased when both sexes were included in the analysis data (Tables 2, 3 and 4).

Goodrich (1974) also found a negative correlation between refractive error and pupil size--as did the studies of Silberkuhle (1896), Tange (1903), and Hirsch and Weymouth (1949)--but the correlation Goodrich found was not significant. This lack of statistical significance may have been due, in part, to the inherent selectiveness of his subject population which consisted of university students. A sample of university students would not necessarily be considered a typical cross-section of the general population, and would be more likely to demonstrate homogeneity with respect to achievement level and academic capabilities. Choosing a subject population among grade and high school students, as done in the present study, is more representative of a population which includes achievers as well as non-achievers.

As stated previously, the average right pupil size was larger than the average left pupil size by 0.3mm (Tables 8, 9 and 10). It may be argued that this may be due to the right eye-left eye sequence in the experimental

set up, but this proposed explanation would not explain why the average right iris diameter was larger than the average left iris diameter, by 0.4mm (Tables 11, 12, and 13). Perhaps this finding is evidence for the validity of eye dominance in that there is a detectable difference between the size of right and left eye structures, as one would expect a difference in the development of right or left arm or leg muscles under the influence of dominance. The assumption is made that most individuals are right eye dominant. Eye dominance was not determined in the present study, however.

Whether or not there exists a correlation between tonic pupil size and the mentally active individual is not directly determined by this study. However, a relationship between myopia and the achieving individual (e.g. Young, 1967) has been reported. This finding suggests the possibility that there is a correlation between larger pupils and the mentally active, achieving individual.

The dependence of variability of refractive error on pupil size points to a variable which has a much greater significance in terms of correlation with refractive error. A larger pupil has a smaller depth of focus--this results in a greater accommodative demand to see clearly at near. If that small amount of increased accommodative demand associated with larger pupils shows an association with myopia, then the person who is engaged in constant near activity, hence constant accommodation, will show even a much greater tendency to be myopic. This idea is further supported by the correlation between myopia and personality patterns of introversion (Beedle and Young, 1976)--those individuals who show personalities of near centeredness are the same individuals who are more likely to become myopic. If then there is a correlation between accommodation and the progression of myopia, it stands to reason that reducing accommodation

by use of plus power reading lenses would reduce the incidence or progression of myopia. Oakley and Young(1975) have found that subjects, ages 9-15, fitted with plus adds at near were effectively prevented from progressing towards or further into myopia, whereas the control group without near adds progressed towards or further into myopia at an average rate of $-.50$ diopters per year. It therefore behooves the eye practitioner to consider such therapy for his near-centered patients.

| INDEX | MEANS | STANDARD DEVIATIONS | |
|-------|---------|---------------------|---------------|
| 1 | 548.228 | 84.3508 | |
| 2 | 550.627 | 75.731 | |
| 3 | 63.1356 | 7.91215 | |
| 4 | 61.8814 | 7.53192 | FEMALES AGE 6 |
| 5 | 52.4497 | 6.02659 | N = 59 |
| 6 | 51.7119 | 5.75374 | |
| 7 | 120.153 | 3.93849 | |
| 8 | 116.797 | 5.82442 | |
| 9 | 7 | 7.68114 | |

CORRELATION COEFFICIENTS

| | | | | |
|-------------|-------------|-------------|----------|----------|
| .999998 | .93353 | -.337529 | -.204037 | -.330569 |
| -.218606 | -.018661 | -3.24315E-2 | .473665 | |
| .93353 | .999998 | -.346329 | -.237852 | -.330859 |
| -.246445 | -.040162 | -5.60326E-2 | .523525 | |
| -.337529 | -.346329 | .999999 | .818828 | .942085 |
| .765532 | .413744 | .302172 | -.186388 | |
| -.204037 | -.237852 | .818828 | 1 | .835578 |
| .915106 | .299405 | .184508 | -.156785 | |
| -.330569 | -.330859 | .942085 | .835578 | .999997 |
| .830108 | .155472 | .150453 | -.163508 | |
| -.218606 | -.246445 | .765532 | .915106 | .830108 |
| .999992 | 3.92541E-2 | -.139137 | -.108453 | |
| -.018661 | -.040162 | .413744 | .299405 | .155472 |
| 3.92541E-2 | .999929 | .733465 | -.173257 | |
| -3.24315E-2 | -5.60326E-2 | .302172 | .184508 | .150453 |
| -.139137 | .733465 | .999937 | -.131801 | |
| .473665 | .523525 | -.186388 | -.156785 | -.163508 |
| -.108453 | -.173257 | -.131801 | 1 | |

| INDEX | MEANS | STANDARD DEVIATIONS | |
|-------|---------|---------------------|---------------|
| 1 | 567.187 | 38.4269 | |
| 2 | 568.75 | 41.3325 | |
| 3 | 64.875 | 7.94039 | |
| 4 | 62.75 | 7.18791 | FEMALES AGE 7 |
| 5 | 53.3125 | 5.77026 | N = 16 |
| 6 | 52.4375 | 5.34128 | |
| 7 | 121.187 | 4.8058 | |
| 8 | 115.437 | 4.27337 | |
| 9 | 9.375 | 9.5 | |

CORRELATION COEFFICIENTS

| | | | | |
|----------|------------|-------------|-------------|------------|
| .999983 | .806702 | .34617 | .30623 | .334956 |
| .293851 | .243134 | .245515 | .227705 | |
| .806702 | .999976 | .261531 | .190736 | .288261 |
| .201946 | 3.14647E-2 | 6.36928E-2 | -.12097 | |
| .34617 | .261531 | 1 | .894148 | .959773 |
| .911498 | .400726 | .263024 | -.197304 | |
| .30623 | .190736 | .894148 | 1.00001 | .855513 |
| .961556 | .431821 | .262073 | -.139123 | |
| .334956 | .288261 | .959773 | .855513 | .999998 |
| .877795 | .163627 | 8.33047E-2 | -.245512 | |
| .293851 | .201946 | .911498 | .961556 | .877796 |
| .999996 | .386164 | .268525 | -.171619 | |
| .243134 | 3.14647E-2 | .400726 | .431821 | .163627 |
| .386164 | 1.00001 | .842992 | .100573 | |
| .245515 | 6.36928E-2 | .263024 | .262073 | 8.33047E-2 |
| .268525 | .842992 | 1.00004 | -8.97028E-2 | |
| .227705 | -.12097 | -.197303 | -.139123 | -.245512 |
| -.171619 | .100573 | -8.97028E-2 | 1 | |

| INDEX | MEANS | STANDARD DEVIATIONS |
|-------|---------|---------------------|
| 1 | 552.20 | 77.2522 |
| 2 | 554.402 | 69.9794 |
| 3 | 63.5267 | 7.89692 |
| 4 | 62.2667 | 7.39675 |
| 5 | 52.6267 | 5.94518 |
| 6 | 51.3667 | 5.64291 |
| 7 | 102.273 | 4.12571 |
| 8 | 116.537 | 5.53204 |
| 9 | 6.21333 | .412419 |

FEMALES AGE 6,7

N = 75

CORRELATION COEFFICIENTS

| | | | | |
|-------------|-------------|-------------|------------|------------|
| .999997 | .925312 | -.245824 | -.142578 | -.248565 |
| -.157342 | 2.37955E-2 | -2.23974E-2 | .12115 | |
| .925312 | .999999 | -.253137 | -.177244 | -.244522 |
| -.134652 | -1.72947E-2 | -5.49873E-2 | .106306 | |
| -.245824 | -.253137 | .999996 | .333663 | .9453 |
| .79399 | .414636 | .282045 | 9.22413E-2 | |
| -.142578 | -.177244 | .333663 | .99999 | .339375 |
| .999913 | .331301 | .139413 | .248433 | |
| -.248565 | -.244522 | .0453 | .339305 | 1 |
| .339453 | .161668 | .132403 | 6.24737E-2 | |
| -.157342 | -.134652 | .79399 | .923918 | .939453 |
| 1 | .121762 | -3.26399E-2 | .253053 | |
| 2.37955E-2 | -1.72947E-2 | .414636 | .331301 | .161668 |
| .121762 | .282045 | .791112 | .132453 | |
| -2.23974E-2 | -5.49873E-2 | .282045 | .139413 | .137403 |
| -3.26399E-2 | .791112 | 1.02024 | -.101322 | |
| .12115 | .106306 | 9.22413E-2 | .248433 | 6.24737E-2 |
| .253053 | .132453 | -.121322 | 1 | |

| INDEX | MEANS | STANDARD DEVIATIONS | |
|-------|-------|---------------------|------------------|
| 1 | 530 | 44.7214 | |
| 2 | 510 | 41.833 | |
| 3 | 67.2 | 6.34036 | |
| 4 | 63.4 | 5.81384 | |
| 5 | 55.6 | 5.22497 | |
| 6 | 53.4 | 5.72715 | |
| 7 | 120.8 | 1.09687 | FEMALES AGE 8-13 |
| 8 | 118.4 | 2.30234 | N = 5 |
| 9 | 9.2 | 1.64317 | |

CORRELATION COEFFICIENTS

| | | | | |
|------------|-------------|-------------|------------|------------|
| 1 | -.534523 | .238054 | -.298074 | 6.41937E-2 |
| -.107369 | .917365 | -.631289 | -.612371 | |
| -.534523 | 1 | -.292192 | 3.08375E-2 | .205878 |
| -.125217 | -.217934 | .597006 | .327326 | |
| .238054 | -.292192 | .999995 | .614456 | .984056 |
| .651296 | -2.87581E-2 | -.417874 | .547114 | |
| -.298073 | 3.08375E-2 | .614456 | .999977 | .664974 |
| .977572 | -.533163 | -.444512 | .486751 | |
| 6.41937E-2 | -.205878 | .984056 | .664974 | .999989 |
| .666685 | -.191935 | -.295104 | .68138 | |
| -.107369 | -.125217 | .651296 | .977572 | .666685 |
| .999991 | -.382047 | -.621878 | .334726 | |
| .917365 | -.217934 | -2.87581E-2 | -.533163 | -.191935 |
| -.382047 | .997403 | -.356383 | -.665799 | |
| -.631289 | .597006 | -.417874 | -.444512 | -.295104 |
| -.621878 | -.356383 | .999853 | .436145 | |
| -.612371 | .327326 | .547114 | .486751 | .68138 |
| .334726 | -.665799 | .436145 | .999996 | |

| INDEX | MEANS | STANDARD DEVIATIONS | | |
|--------------------------|-------------|---------------------|-------------|-------------|
| 1 | 502.936 | 64.5688 | | |
| 2 | 505.412 | 61.7024 | | |
| 3 | 64.0941 | 8.6762 | | |
| 4 | 63.3294 | 8.06725 | | |
| 5 | 53.6353 | 7.01164 | | |
| 6 | 51.2118 | 6.66746 | | |
| 7 | 118.8 | 5.26634 | | |
| 8 | 114.941 | 6.36273 | | |
| 9 | 14.4824 | 4.44708 | | |
| FEMALES AGE 14 | | | | |
| N = 85 | | | | |
| CORRELATION COEFFICIENTS | | | | |
| .999996 | .878844 | -2.49526E-2 | -4.53262E-2 | 1.12358E-2 |
| 1.29089E-3 | -5.23779E-2 | -.116661 | -4.94002E-3 | |
| .878844 | .999992 | -.016752 | -2.92172E-2 | 9.87241E-3 |
| -4.35762E-5 | -9.02024E-3 | -5.79237E-2 | 7.93106E-2 | |
| -2.49526E-2 | -.016752 | 1.00001 | .877014 | .938905 |
| .80821 | .340167 | .148022 | -2.64912E-2 | |
| -4.53262E-2 | -2.92172E-2 | .877014 | 1 | .829897 |
| .890193 | .291024 | .209116 | -.154139 | |
| 1.12358E-2 | 9.87241E-3 | .938905 | .829897 | .999999 |
| .870022 | -1.96018E-2 | -.089082 | -4.12515E-2 | |
| 1.29089E-3 | -4.35762E-5 | .80821 | .890193 | .870022 |
| .999984 | -3.86107E-3 | -.173125 | -.168101 | |
| -5.23779E-2 | -9.02024E-3 | .340167 | .291024 | 1.96018E-2 |
| -3.86107E-3 | .999963 | .677117 | 2.50093E-2 | |
| -.116661 | -5.79237E-2 | .148022 | .209116 | -.089082 |
| -.173125 | .677117 | .999992 | -.050735 | |
| -4.94002E-3 | 7.93106E-2 | -2.64912E-2 | -.154139 | -4.12515E-2 |
| -.168101 | 2.50093E-2 | -.050735 | 1 | |

| INDEX | MEANS | STANDARD DEVIATIONS |
|-------|---------|---------------------|
| 1 | 600.667 | 212.338 |
| 2 | 595.778 | 197.271 |
| 3 | 63.3333 | 7.25989 |
| 4 | 59.9444 | 6.5482 |
| 5 | 52.6111 | 5.40304 |
| 6 | 51 | 5.70858 |
| 7 | 119 | 3.16228 |
| 8 | 114.833 | 5.13642 |
| 9 | 17.2778 | 9.66379 |

FEMALES AGE 15

N = 18

CORRELATION COEFFICIENTS

| | | | | |
|------------|------------|-------------|-------------|-------------|
| 1 | .972192 | -.409366 | -.588406 | -.481672 |
| -.633198 | .163294 | .176089 | .704414 | |
| .972192 | 1 | -.483705 | -.6001 | -.539721 |
| -.661398 | .13436 | .182881 | .574637 | |
| -.409366 | -.483705 | .999997 | .898742 | .952761 |
| .855874 | .351028 | .121465 | -4.58348E-2 | |
| -.588406 | -.6001 | .898742 | 1 | .880538 |
| .944175 | .258506 | .116886 | -.340894 | |
| -.481672 | -.539721 | .952761 | .880538 | .999998 |
| .888731 | .120498 | -9.57349E-2 | -7.44174E-2 | |
| -.633198 | -.661398 | .855874 | .944175 | .888731 |
| 1.00001 | 1.62927E-2 | -.10432 | -.349743 | |
| .163294 | .13436 | .351028 | .258506 | .120498 |
| 1.62927E-2 | 1 | .778626 | .23676 | |
| .176089 | .182881 | .121465 | .116886 | -9.57349E-2 |
| .10432 | .778626 | .999983 | -4.04898E-2 | |
| .704414 | .574637 | -4.58348E-2 | -.340894 | -7.44174E-2 |
| .349743 | .23676 | -4.04898E-2 | 1 | |

| INDEX | MEANS | STANDARD DEVIATIONS |
|-------|---------|---------------------|
| 1 | 513.991 | 111.025 |
| 2 | 501.204 | 123.974 |
| 3 | 63.9619 | 3.41792 |
| 4 | 68.2621 | 7.79514 |
| 5 | 53.4563 | 6.74577 |
| 6 | 51.1742 | 6.48443 |
| 7 | 113.335 | 4.95993 |
| 8 | 114.922 | 6.14331 |
| 9 | 14.1456 | .49324 |

FEMALES AGE 14,15
N = 103

CORRELATION COEFFICIENTS

| | | | | |
|-------------|-------------|-------------|-------------|-------------|
| 1 | .948673 | -.136369 | -.136259 | -.136777 |
| -.131141 | 1.17411E-2 | -1.31935E-2 | .270553 | |
| .948673 | .999994 | -.151793 | -.18044 | -.1509 |
| -.133271 | 2.75733E-2 | 1.63235E-2 | .240294 | |
| -.136369 | -.151793 | .999994 | .37957 | .940642 |
| .314112 | .333317 | .144979 | -1.27919E-2 | |
| -.136259 | -.1509 | .37957 | .999993 | .735016 |
| .396712 | .286647 | .192379 | 7.15943E-2 | |
| -.136777 | -.1509 | .240294 | .325016 | 1 |
| .270553 | 2.79922E-2 | -3.92324E-2 | -2.31145E-2 | |
| -.131141 | -.138271 | .314112 | .896712 | .870915 |
| .999994 | -2.15349E-3 | -.164544 | .283923 | |
| 1.17411E-2 | 2.75733E-2 | .333317 | .286647 | 2.72232E-2 |
| -2.15349E-3 | .999993 | .633551 | -2.13276E-3 | |
| -1.31935E-2 | 1.63235E-2 | .144979 | .193359 | -3.92324E-2 |
| -.164544 | .633551 | .999993 | 2.31145E-2 | |
| .270553 | .240294 | -1.27919E-2 | 7.15943E-2 | -2.31145E-2 |
| .240294 | -2.15349E-3 | 2.31145E-2 | 1.90021 | |

| INDEX | MEANS | STANDARD DEVIATIONS |
|-------|---------|---------------------|
| 1 | 533.514 | 92.2947 |
| 2 | 534.541 | 91.4212 |
| 3 | 63.7624 | 5.14355 |
| 4 | 61.2074 | 7.61332 |
| 5 | 53.1749 | 6.38735 |
| 6 | 51.5191 | 6.11966 |
| 7 | 119.519 | 4.61464 |
| 8 | 115.667 | 5.3755 |
| 9 | 11 | 5.19225 |

FEMALES AGE 6-15

N = 183

| CORRELATION COEFFICIENTS | | | | |
|--------------------------|------------|-------------|------------|-------------|
| .999965 | .934386 | -.168536 | -.149224 | -.175624 |
| -.160735 | 4.93400E-9 | 3.32065E-3 | -.129322 | |
| .634526 | .999937 | -.186519 | -.152723 | -.188123 |
| -.173749 | 4.63119E-9 | 1.73175E-2 | -.17635 | |
| -.169524 | -.134519 | .999927 | .849405 | .941879 |
| .379999 | .355429 | .191565 | 1.15065E-2 | |
| -.149994 | -.150793 | .349405 | 1.00001 | .81974 |
| .906117 | .31256 | .995753 | -.15756 | |
| -.175624 | -.173103 | .941373 | .81974 | .999999 |
| .85013 | 6.31174E-2 | -1.35164E-2 | 3.32116E-2 | |
| -.160735 | -.173749 | .860398 | .906117 | .85013 |
| .999979 | 4.79459E-9 | -.195476 | -.117394 | |
| 4.93400E-9 | 4.63119E-9 | .355429 | .31256 | 6.38186E-2 |
| 4.30659E-9 | 1 | .700353 | -.119257 | |
| 6.30647E-9 | 1.73175E-2 | .191565 | .995753 | -1.35164E-2 |
| -.125476 | .700353 | .999939 | -.134167 | |
| -.107122 | -.134167 | 1.15065E-2 | -.15756 | 3.32116E-2 |
| -.117394 | -.119257 | -.134167 | 1 | |

| INDEX | MEANS | STANDARD DEVIATIONS |
|-------|---------|---------------------|
| 1 | 551.994 | 74.8717 |
| 2 | 554.167 | 71.5996 |
| 3 | 64.9424 | 6.27339 |
| 4 | 61.3636 | 5.9663 |
| 5 | 59.6667 | 4.97983 |
| 6 | 51.7879 | 4.64596 |
| 7 | 121.455 | 4.65153 |
| 8 | 117.5 | 5.63475 |
| 9 | 6.74949 | 6.93143 |

MALES AGE 6

N = 66

| CORRELATION COEFFICIENTS | | | | |
|--------------------------|-------------|-------------|-------------|-------------|
| .999991 | .933934 | -3.29423E-2 | -.127349 | -1.51375E-2 |
| -3.24295E-2 | -.257264 | -.175562 | -3.75629E-2 | |
| .933934 | .999989 | -2.96759E-2 | -3.23326E-2 | 5.11646E-2 |
| -.935463 | -.299937 | -.214249 | -9.45535E-2 | |
| -9.29423E-2 | -9.96759E-2 | 1.23661 | .801993 | .924951 |
| .750307 | .256667 | .289212 | -.20436 | |
| -.127349 | -3.63767E-2 | .801993 | .999989 | .712002 |
| .756449 | .233423 | .389316 | -.143733 | |
| -1.51375E-2 | 5.11646E-2 | .924951 | .712002 | 1 |
| .812499 | -3.63978E-2 | -6.24269E-2 | -.246568 | |
| -9.24269E-2 | -.735463 | .750307 | .856442 | .810499 |
| 1.80091 | -.127192 | -.135706 | -.182607 | |
| -.257264 | -.299937 | .256667 | .233433 | -3.63978E-2 |
| -.127192 | .999941 | .716152 | .122135 | |
| -.175562 | -.214249 | .289212 | .389316 | -6.24269E-2 |
| -.135706 | .716152 | .999961 | .122923 | |
| -3.75629E-2 | -9.45535E-2 | -.20406 | -.143733 | -.246568 |
| -.122607 | .122135 | .120923 | 1 | |

| INDEX | MEANS | STANDARD DEVIATIONS | | |
|--------------------------|-------------|---------------------|-----------------------|-------------|
| 1 | 598.299 | 77.1257 | | |
| 2 | 538.297 | 21.7537 | | |
| 3 | 65.9167 | 6.3999 | | |
| 4 | 63.25 | 6.42347 | MALES AGE 7 N = 24 | |
| 5 | 54.4733 | 5.2296 | | |
| 6 | 51.9167 | 5.5733 | | |
| 7 | 122.25 | 4.25527 | | |
| 8 | 116.792 | 4.81318 | | |
| 9 | 3.125 | 5.51135 | | |
| CORRELATION COEFFICIENTS | | | | |
| 1-2 | .953963 | -9.92166E-2 | -.141927 | -7.72711E-2 |
| 1-3 | -.151491 | .362653 | .186967 | |
| 1-4 | .953963 | -.248122 | -.296266 | -.215212 |
| 1-5 | -.337416 | .2347 | .181333 | |
| 1-6 | -.248122 | 1.029001 | .920654 | .319502 |
| 1-7 | .337416 | -.317715 | 2.57622E-3 | |
| 1-8 | -.141927 | .920654 | 1.23092 | .654206 |
| 1-9 | .953963 | .349378 | -4.14172E-2 | |
| 2-3 | -7.72711E-2 | .619532 | .654206 | 1.00001 |
| 2-4 | .790515 | -3.22314E-3 | .03882 | |
| 2-5 | -.192264 | .890023 | .906223 | .790515 |
| 2-6 | 1 | .246234 | 3.18167E-3 | |
| 2-7 | -.151491 | .331364 | .483976 | -.133061 |
| 2-8 | .163918 | .664231 | -6.25691E-2 | |
| 2-9 | .362653 | .317715 | .349873 | -8.22314E-3 |
| 3-4 | .246234 | 1.00003 | 5.34173E-2 | |
| 3-5 | .186967 | 2.57622E-3 | -4.14172E-2 | .03882 |
| 3-6 | 3.18167E-3 | 5.34173E-2 | 1 | |
| 3-7 | -.25691E-2 | | | |

| INDEX | MEANS | STANDARD DEVIATIONS | |
|-------|---------|---------------------|---------------|
| 1 | 560 | 75.679 | |
| 2 | 561.111 | 74.8682 | |
| 3 | 64.6889 | 6.44713 | |
| 4 | 62.2333 | 6.0875 | |
| 5 | 53.0444 | 4.94669 | MALES AGE 6,7 |
| 6 | 51.8222 | 4.8796 | N = 90 |
| 7 | 121.667 | 4.53954 | |
| 8 | 117.311 | 5.44988 | |
| 9 | 6.26667 | .444695 | |

CORRELATION COEFFICIENTS

| | | | | |
|-------------|-------------|-------------|-------------|-------------|
| .999988 | .94191 | -6.49469E-2 | -.110599 | -8.70799E-3 |
| -.125211 | -.211781 | -7.30149E-2 | .178611 | |
| .94191 | .999995 | -7.71383E-2 | -.12903 | -6.65565E-3 |
| -.130635 | -.260905 | -.106312 | .154672 | |
| -6.49469E-2 | -7.71383E-2 | .999991 | .832975 | .895315 |
| .790397 | .294333 | .226009 | .115482 | |
| -.110599 | -.12903 | .832975 | .999988 | .699273 |
| .86762 | .302939 | .304297 | .101274 | |
| -8.70799E-3 | -6.65565E-3 | .895315 | .699273 | 1.00001 |
| .797251 | -8.69072E-2 | -5.63489E-2 | .127354 | |
| -.125211 | -.130635 | .790397 | .86762 | .797251 |
| 1.00001 | -4.43215E-2 | -8.70562E-2 | 1.17368E-2 | |
| -.211782 | -.260905 | .294333 | .302939 | -8.69072E-2 |
| -4.43215E-2 | .999943 | .696787 | 7.79227E-2 | |
| -7.30149E-2 | -.106312 | .226009 | .304297 | -5.63489E-2 |
| -8.70562E-2 | .696787 | .999923 | -5.77978E-2 | |
| .178611 | .154672 | .115481 | .101274 | .127354 |
| 1.17368E-2 | 7.79226E-2 | -5.77978E-2 | .999995 | |

| INDEX | MEANS | STANDARD DEVIATIONS |
|-------|---------|---------------------|
| 1 | 547.467 | 103.115 |
| 2 | 540.5 | 176.751 |
| 3 | 64.9333 | 6.14665 |
| 4 | 61.6667 | 5.61457 |
| 5 | 53.4667 | 4.73382 |
| 6 | 51.6 | 3.71368 |
| 7 | 100.333 | 7.40303 |
| 8 | 116.333 | 7.37447 |
| 9 | 12.0667 | 2.28244 |

MALES AGE 8-13
N = 15

CORRELATION COEFFICIENTS

| | | | | |
|-------------|-------------|-------------|------------|-------------|
| .999993 | -.160355 | -.10273 | -.135308 | -2.33038E-3 |
| .100493 | -.154704 | -.378225 | .421427 | |
| -.160355 | .999993 | -8.02236E-2 | .149356 | .244526 |
| .396198 | -.450447 | -.485037 | .244904 | |
| -.10273 | -8.02236E-2 | .999992 | .806511 | .725312 |
| .533118 | .413057 | .656061 | -.462976 | |
| -.135308 | .149356 | .806511 | 1.00001 | .715753 |
| .800538 | .160059 | .510067 | -.332574 | |
| -2.33038E-3 | .244526 | .725312 | .715753 | .999994 |
| .306643 | -.290093 | .130267 | -.163356 | |
| .100493 | .396198 | .533118 | .800533 | .306643 |
| .999997 | -.27502 | -1.04137E-2 | 9.59376E-2 | |
| -.154704 | -.450447 | .413057 | .160059 | -.290093 |
| -.27502 | 1.00000 | .716092 | -.314219 | |
| -.378225 | -.485037 | .656061 | .510067 | .130267 |
| -1.04137E-2 | .716092 | .999966 | -.548849 | |
| .421427 | .244904 | -.462976 | -.332574 | -.163356 |
| 9.59376E-2 | -.314219 | -.548849 | 1 | |

| INDEX | MEANS | STANDARD DEVIATIONS | |
|-------|---------|---------------------|--------------|
| 1 | 464.932 | 136.965 | |
| 2 | 405.070 | 137.905 | |
| 3 | 64.7952 | 7.96304 | |
| 4 | 61.3412 | 7.95882 | MALES AGE 14 |
| 5 | 53.7463 | 6.24572 | N = 79 |
| 6 | 51.5316 | 6.11314 | |
| 7 | 122.632 | 4.64775 | |
| 8 | 116.412 | 5.4904 | |
| 9 | 15.6276 | 9.67575 | |

CORRELATION COEFFICIENTS

| | | | | |
|------------|-------------|------------|------------|------------|
| .999992 | .932954 | -.224019 | -.232031 | -.193749 |
| -.255125 | -.231484 | .072346 | .113166 | |
| .932954 | 1 | -.242351 | -.257774 | -.214256 |
| -.291254 | -8.53327E-2 | 7.17559E-2 | 7.00247E-2 | |
| -.224019 | -.242351 | 1 | .335427 | .945244 |
| .74742 | .445916 | .352762 | 4.16773E-3 | |
| -.232031 | -.257774 | .335427 | 1 | .824692 |
| .92416 | .342727 | .322395 | 5.23223E-2 | |
| -.193749 | -.214255 | .945244 | .824692 | .999992 |
| .816133 | .148175 | .134547 | 6.13164E-2 | |
| -.255125 | -.231254 | .74742 | .92416 | .816133 |
| .999992 | 5.47426E-2 | 1.35273E-2 | .139099 | |
| -.231484 | -3.53327E-2 | .445916 | .342727 | .148175 |
| 5.47426E-2 | .999964 | .705257 | -.143036 | |
| .072346 | 7.17559E-2 | .352762 | .322395 | .134547 |
| 1.35274E-2 | .705257 | .999965 | -.112443 | |
| .113166 | 7.00247E-2 | 4.16773E-3 | 5.23223E-2 | 6.13164E-2 |
| .139099 | -.143036 | -.112443 | 1 | |

| INDEX | MEANS | STANDARD DEVIATIONS | | |
|--------------------------|------------|---------------------|-------------|----------|
| 1 | 539.13 | 152.223 | | |
| 2 | 548.739 | 144.833 | | |
| 3 | 63.4343 | 8.79991 | | |
| 4 | 59.3696 | 9.91467 | | |
| 5 | 59.3913 | 6.91335 | | |
| 6 | 49.3696 | 6.96945 | | |
| 7 | 128.837 | 5.38444 | | |
| 8 | 117.733 | 4.31453 | | |
| 9 | 15.1384 | .344327 | | |
| MALES AGE 15 | | | | |
| N = 23 | | | | |
| CORRELATION COEFFICIENTS | | | | |
| 1 | .974378 | -.514637 | -.473826 | -.532442 |
| -.44484 | -.327379 | -.167798 | .310123 | |
| .974378 | .999997 | -.54734 | -.437595 | -.556211 |
| -.395474 | -.333581 | -.214566 | .309422 | |
| -.514637 | -.54734 | 1 | .332162 | .959411 |
| .773976 | .427977 | .396874 | -.469605 | |
| -.473826 | -.437595 | .832162 | .999996 | .356239 |
| .941726 | .313664 | .367895 | -.34097 | |
| -.532442 | -.556211 | .959411 | .356239 | 1 |
| .34544 | .282967 | .282627 | -.42341 | |
| -.44484 | -.395474 | .773976 | .941726 | .345439 |
| .999993 | 9.47945E-2 | .165738 | -.409295 | |
| -.327379 | -.333581 | .427977 | .313664 | .282967 |
| 9.47945E-2 | .999997 | .463922 | -.282531 | |
| -.167798 | -.214566 | .396874 | .367895 | .282627 |
| .165738 | .463922 | .999922 | -6.43753E-2 | |
| .310123 | .383489 | -.469605 | -.34097 | -.42341 |
| -.409295 | -.282531 | -6.43753E-2 | 1.32214 | |

| INDEX | MEANS | STANDARD DEVIATIONS | |
|-------|---------|---------------------|-----------------|
| 1 | 480.971 | 143.236 | |
| 2 | 482.294 | 142.162 | |
| 3 | 64.4118 | 8.12938 | |
| 4 | 63.9804 | 8.39965 | MALES AGE 14,15 |
| 5 | 53.4314 | 6.2371 | N = 102 |
| 6 | 51.1176 | 6.28576 | |
| 7 | 120.049 | 4.79583 | |
| 8 | 116.706 | 5.37809 | |
| 9 | 14.2549 | .501219 | |

CORRELATION COEFFICIENTS

| | | | | |
|------------|-------------|------------|-------------|----------|
| .999999 | .981547 | -.306372 | -.310879 | -.296657 |
| -.327139 | -.142437 | 3.86452E-2 | .257866 | |
| .981548 | .999999 | -.322319 | -.315038 | -.31275 |
| -.336903 | -.143641 | 3.44844E-2 | .256698 | |
| -.306372 | -.322319 | .999995 | .83457 | .949003 |
| .75858 | .441344 | .350401 | -.137791 | |
| -.310879 | -.315038 | .83457 | .999998 | .819231 |
| .929603 | .339201 | .32094 | -.128147 | |
| -.296657 | -.31275 | .949003 | .819231 | .999995 |
| .826535 | .164126 | .154344 | -.155873 | |
| -.327139 | -.336903 | .75858 | .929603 | .826535 |
| 1 | 7.30556E-2 | 3.87983E-2 | -.169887 | |
| -.142437 | -.143641 | .441344 | .339201 | .164126 |
| 7.30556E-2 | .999995 | .646592 | -2.98826E-2 | |
| 3.86452E-2 | 3.44844E-2 | .350401 | .32094 | .154344 |
| 3.87983E-2 | .646592 | .999929 | 9.42021E-2 | |
| .257866 | .256698 | -.137791 | -.128147 | -.155873 |
| -.169887 | -2.98826E-2 | 9.42021E-2 | .999971 | |

| INDEX | MEANS | STANDARD DEVIATIONS |
|-------|---------|---------------------|
| 1 | 522.15 | 121.525 |
| 2 | 520.309 | 126.199 |
| 3 | 64.57 | 7.27702 |
| 4 | 61.5749 | 7.23765 |
| 5 | 53.2657 | 5.53624 |
| 6 | 51.4529 | 5.52914 |
| 7 | 120.773 | 4.95251 |
| 8 | 111.042 | 5.55196 |
| 9 | 10.4773 | 3.32258 |

MALES AGE 6 - 15

N = 207

| CORRELATION | CORRELATION | | | |
|-------------|-------------|-------------|-------------|------------|
| .999997 | .673339 | -.211673 | -.211796 | -.203449 |
| -.228241 | -9.74711E-9 | -.01221 | -.270646 | |
| .673339 | .999997 | -.216695 | -.192103 | -.18424 |
| -.196469 | -.15609 | -5.53604E-2 | -.26033 | |
| -.211673 | -.216695 | 1 | .330435 | .913629 |
| .75936 | .375763 | .32141 | -3.35079E-2 | |
| -.211796 | -.192103 | .330435 | .999997 | .769392 |
| .904719 | .311342 | .323204 | -9.66035E-2 | |
| -.203449 | -.18424 | .913629 | .769392 | .999938 |
| .313917 | 2.60399E-2 | .663572 | 2.14214E-2 | |
| -.228241 | -.196469 | .75936 | .904719 | .810917 |
| .999997 | 1.45999E-9 | -9.24332E-3 | -6.93192E-2 | |
| -9.74711E-9 | -.15609 | .375763 | .311342 | 2.60399E-2 |
| 1.45999E-9 | .999993 | .673339 | -.170557 | |
| -.01221 | -5.53604E-2 | .32141 | .323204 | .663572 |
| -9.24332E-3 | .673339 | .999992 | -7.65061E-2 | |
| -.270646 | -.26033 | -3.35079E-2 | -9.66035E-2 | 2.14214E-2 |
| -6.93192E-2 | -.170557 | -7.65061E-2 | 1 | |

| INDEX | MEANS | STANDARD DEVIATIONS | |
|-------|---------|---------------------|-------------------|
| 1 | 550.199 | 78.7335 | |
| 2 | 550.496 | 73.999 | |
| 3 | 63.79 | 7.92655 | |
| 4 | 61.372 | 6.767 | |
| 5 | 30.56 | 5.43943 | MALES AND FEMALES |
| 6 | 51.750 | 5.17695 | AGE 6 N = 125 |
| 7 | 129.24 | 4.36159 | |
| 8 | 117.162 | 5.73061 | |
| 9 | 6.120 | 1.59053 | |

CORRELATION COEFFICIENTS

| | | | | |
|----------|------------|-------------|-------------|------------|
| .999999 | .933121 | -.223114 | -.179151 | -.139685 |
| -.165461 | -.1491 | -.109263 | .343099 | |
| .93312 | .93999 | -.192484 | -.16613 | -.153043 |
| -.143475 | -.177924 | -.13456 | .365953 | |
| -.933112 | -.193404 | 1 | .889265 | .933026 |
| .757564 | .33357 | .261167 | -.149116 | |
| -.179151 | -.16613 | .369265 | 1.999997 | .783393 |
| .7905 | .257212 | .937549 | -.119269 | |
| -.129615 | -.159072 | .933026 | .783393 | .99999 |
| .591748 | 3.83715E-2 | 5.12247E-2 | -.125315 | |
| -.165461 | -.143475 | .357564 | .6905 | .891748 |
| .99999 | -.744999 | -.136905 | -3.27699E-2 | |
| -.1491 | -.177924 | .33357 | .257313 | 3.83715E-2 |
| -.644999 | .999927 | .799244 | -.129786 | |
| -.159063 | -.13456 | .261167 | .237549 | 5.12247E-2 |
| -.136905 | .799046 | .939997 | -9.69179E-2 | |
| .343099 | .315953 | -.149116 | -.119269 | -.125315 |
| -.933026 | -.129726 | -9.69179E-2 | .999993 | |

| INDEX | MEANS | STANDARD DEVIATIONS | |
|-------|---------|---------------------|-------------------|
| 1 | 576.25 | 64.2974 | |
| 2 | 575.625 | 68.0514 | |
| 3 | 65.5 | 7.24656 | |
| 4 | 63.05 | 6.75621 | MALES AND FEMALES |
| 5 | 53.775 | 5.27931 | AGE 7 N = 40 |
| 6 | 52.125 | 5.42163 | |
| 7 | 121.825 | 4.45441 | |
| 8 | 116.25 | 4.60065 | |
| 9 | 7.95 | 6.00833 | |

CORRELATION COEFFICIENTS

| | | | | |
|-------------|-------------|-------------|-------------|-------------|
| 1 | .937564 | 2.88959E-2 | -1.66222E-2 | 4.05248E-2 |
| -8.32184E-2 | -2.82948E-2 | .293685 | 5.99105E-2 | |
| .937564 | .999986 | -9.42367E-2 | -.151492 | -6.56041E-2 |
| -.203488 | -.132837 | .200161 | -.061065 | |
| 2.88959E-2 | -9.42367E-2 | 1 | .897322 | .885044 |
| .888569 | .39519 | .29995 | -.145461 | |
| -1.66222E-2 | -.151492 | .897322 | .999999 | .746059 |
| .922793 | .461243 | .315249 | -9.86719E-2 | |
| 4.05248E-2 | -6.56041E-2 | .885044 | .746059 | 1 |
| .817115 | 1.13942E-2 | .038269 | -.177395 | |
| -8.32184E-2 | -.203488 | .888569 | .922793 | .817115 |
| 1.00001 | .247278 | .116933 | -.093473 | |
| -2.82948E-2 | -.132837 | .39519 | .461243 | 1.13942E-2 |
| .247278 | .999962 | .734202 | 4.27773E-2 | |
| .293685 | .200161 | .29995 | .315249 | .038269 |
| .116933 | .734202 | 1.00003 | -7.93101E-2 | |
| 5.99105E-2 | -.061065 | -.145461 | -9.86719E-2 | -.177395 |
| -9.34729E-2 | 4.27773E-2 | -7.93101E-2 | 1 | |

| INDEX | MEANS | STANDARD DEVIATIONS | | |
|-------|---------|---------------------|--|--|
| 1 | 556.599 | 76.1659 | | |
| 2 | 559.193 | 79.5399 | | |
| 3 | 64.1515 | 7.1445 | | |
| 4 | 69.1576 | 6.69363 | | |
| 5 | 59.8545 | 5.41631 | | |
| 6 | 51.8494 | 5.29375 | | |
| 7 | 121.479 | 4.39194 | | |
| 8 | 116.945 | 5.48594 | | |
| 9 | 6.34545 | 1.37333 | | |

MALES AND FEMALES
AGE 6,7 N = 165

| CORRELATION COEFFICIENTS | | | | |
|--------------------------|-------------|-------------|-------------|-------------|
| .999997 | .934371 | -.15146 | -.125542 | -.127025 |
| -.141124 | -.103616 | -4.49436E-2 | .336373 | |
| .934371 | .999983 | -.157624 | -.150416 | -.118623 |
| -.155362 | -.151475 | -7.89547E-2 | .346699 | |
| -.15146 | -.157624 | .999999 | .831453 | .922131 |
| .738397 | .355591 | .25785 | -9.43528E-2 | |
| -.125542 | -.150416 | .331453 | .999956 | .776156 |
| .397526 | .311572 | .245399 | -7.95893E-2 | |
| -.127025 | -.118623 | .922131 | .776156 | .999992 |
| .918925 | 3.63873E-2 | 4.12926E-2 | -7.93596E-2 | |
| -.141124 | -.155362 | .738397 | .397526 | .818925 |
| .999984 | 3.19169E-2 | -.634823 | -6.03703E-2 | |
| -.103616 | -.151475 | .355591 | .311572 | 3.63873E-2 |
| 3.19169E-2 | .999957 | .727494 | -7.42973E-2 | |
| -4.49436E-2 | -7.89547E-2 | .25785 | .245399 | 4.12926E-2 |
| -.634823 | .727494 | .999957 | -.124335 | |
| .336373 | .346699 | -9.43528E-2 | -7.95893E-2 | -7.93596E-2 |
| | | | | |

| INDEX | MEANS | STANDARD DEVIATIONS | |
|-------|--------|---------------------|-------------------|
| 1 | 543.1 | 91.1887 | |
| 2 | 533.1 | 153.543 | |
| 3 | 65.5 | 6.10872 | |
| 4 | 62.1 | 5.56206 | |
| 5 | 54 | 4.81225 | MALES AND FEMALES |
| 6 | 52.85 | 4.21116 | AGE 8-13 N = 20 |
| 7 | 128.45 | 6.37822 | |
| 8 | 116.85 | 6.483 | |
| 9 | 9.85 | 2.13431 | |

CORRELATION COEFFICIENTS

| | | | | |
|-------------|----------|-------------|-------------|-------------|
| .999999 | -.163169 | -7.46419E-2 | -.15775 | -1.15141E-2 |
| 4.93271E-2 | -.136881 | -.393649 | .34217 | |
| -.163169 | 1 | -.108555 | .117821 | .173661 |
| .270071 | -.448524 | -.468494 | .252681 | |
| -7.46419E-2 | -.108555 | .999984 | .766772 | .794935 |
| .573889 | .364046 | .54422 | -.30478 | |
| -.15775 | .117821 | .766772 | 1.00001 | .709856 |
| .844658 | .123286 | .416425 | -.207848 | |
| -1.15141E-2 | .173661 | .794935 | .709856 | 1.00001 |
| .760964 | -.245808 | .111344 | -4.61195E-2 | |
| 4.93271E-2 | .270071 | .573889 | .844658 | .760964 |
| 1.00002 | -.220346 | -4.40509E-2 | .106283 | |
| -.136881 | -.448524 | .364046 | .123286 | -.245808 |
| -.220346 | .999999 | .696685 | -.311813 | |
| -.393649 | -.468494 | .54422 | .416425 | .111344 |
| -4.40509E-2 | .696685 | .999992 | -.492397 | |
| .34217 | .252681 | -.30478 | -.207848 | -4.61195E-2 |
| .106283 | -.311813 | -.492397 | .999999 | |

| INDEX | MEANS | STANDARD DEVIATIONS |
|-------|---------|---------------------|
| 1 | 484.183 | 107.222 |
| 2 | 486.979 | 107.083 |
| 3 | 64.3841 | 8.31913 |
| 4 | 60.7988 | 8.00015 |
| 5 | 53.6829 | 6.54175 |
| 6 | 51.3415 | 6.36944 |
| 7 | 119.394 | 5.00156 |
| 8 | 115.64 | 5.99805 |
| 9 | 14.25 | 3.20156 |

MALES AND FEMALES

AGE 14 N = 164

CORRELATION COEFFICIENTS

| | | | | |
|-------------|-------------|-------------|-------------|-------------|
| 1 | .964689 | -.146569 | -.169215 | -.108228 |
| -.158033 | -8.59655E-2 | -2.37208E-2 | 1.15913E-2 | |
| .964689 | 1 | -.154311 | -.180049 | -.121048 |
| -.179446 | -7.50627E-2 | -2.19177E-3 | 4.68969E-2 | |
| -.146569 | -.154311 | .999989 | .857893 | .940853 |
| .783654 | .387614 | .237501 | -2.25117E-2 | |
| -.169215 | -.180049 | .857893 | .999999 | .815486 |
| .90505 | .321216 | .265057 | -.115866 | |
| -.108228 | -.121048 | .940853 | .815486 | 1 |
| .847454 | 7.43801E-2 | 3.32538E-3 | -3.22218E-2 | |
| -.158033 | -.179446 | .783654 | .90505 | .847454 |
| 1 | 2.84827E-2 | -8.84541E-2 | -.12756 | |
| -8.59655E-2 | -7.50627E-2 | .387614 | .321216 | 7.43801E-2 |
| 2.84827E-2 | .999932 | .694308 | 9.49412E-3 | |
| -2.37208E-2 | -2.19177E-3 | .237501 | .265057 | 3.32538E-3 |
| -8.84541E-2 | .694308 | .999932 | -4.76723E-2 | |
| 1.15913E-2 | 4.68969E-2 | -2.25117E-2 | -.115866 | -3.22218E-2 |
| -.12756 | 9.49412E-3 | -4.76723E-2 | 1 | |

| INDEX | MEANS | STANDARD DEVIATIONS | |
|-------|---------|---------------------|-------------------|
| 1 | 566.146 | 181.28 | |
| 2 | 564.902 | 169.451 | |
| 3 | 63.3902 | 8.06189 | |
| 4 | 59.9024 | 8.50238 | |
| 5 | 52.4878 | 6.22142 | MALES AND FEMALES |
| 6 | 50.3659 | 6.39439 | AGE 15 N = 41 |
| 7 | 119.61 | 4.52705 | |
| 8 | 116.488 | 5.11432 | |
| 9 | 15.0732 | .263665 | |

CORRELATION COEFFICIENTS

| | | | | |
|-------------|------------|-------------|------------|----------|
| .999998 | .973956 | -.444029 | -.480022 | -.478467 |
| -.49018 | -.143632 | -3.43049E-2 | .144641 | |
| .973956 | .999999 | -.495856 | -.466506 | -.517967 |
| -.479164 | -.158733 | -.050828 | .142837 | |
| -.444029 | -.495856 | .999997 | .847455 | .956605 |
| .798312 | .400205 | .27235 | -.366635 | |
| -.480021 | -.466506 | .847455 | .999997 | .860614 |
| .934595 | .301657 | .259249 | -.286685 | |
| -.478467 | -.517967 | .956605 | .860614 | 1 |
| .857597 | .176445 | .121958 | -.342353 | |
| -.49018 | -.479164 | .798312 | .934595 | .857597 |
| .999991 | 6.11701E-2 | 2.80425E-2 | -.342496 | |
| -.143632 | -.158733 | .400205 | .301657 | .176445 |
| 6.11701E-2 | .999992 | .5558 | -.143037 | |
| -3.43049E-2 | -.050828 | .27235 | .259249 | .121958 |
| 2.80425E-2 | .5558 | .999995 | 2.84877E-2 | |
| .144641 | .142837 | -.366635 | -.286685 | -.342353 |
| -.342496 | -.143037 | 2.84877E-2 | .999992 | |

| INDEX | MEANS | STANDARD DEVIATIONS | |
|-------|---------|---------------------|-------------------|
| 1 | 500.576 | 129.265 | |
| 2 | 591.844 | 125.662 | |
| 3 | 64.1854 | 8.2524 | |
| 4 | 60.6195 | 8.08971 | |
| 5 | 53.4439 | 6.48176 | |
| 6 | 51.1463 | 6.37975 | MALES AND FEMALES |
| 7 | 119.439 | 4.90037 | AGE 14,15 |
| 8 | 115.81 | 5.82995 | |
| 9 | 14.4146 | 2.88315 | |

CORRELATION COEFFICIENTS

| | | | | |
|-------------|-------------|-------------|-------------|-------------|
| .999998 | .969893 | -.22932 | -.260936 | -.217479 |
| -.255618 | -9.02595E-2 | -9.69874E-3 | 4.12763E-2 | |
| .969893 | 1 | -.245963 | -.262052 | -.233229 |
| -.264767 | -8.65845E-2 | 1.25337E-3 | 6.77065E-2 | |
| -.22932 | -.245963 | .999996 | .855494 | .943612 |
| .786968 | .388404 | .239571 | -3.20645E-2 | |
| -.260936 | -.262052 | .855494 | .999997 | .823855 |
| .911043 | .315705 | .259753 | -.112159 | |
| -.217479 | -.233229 | .943612 | .823855 | .999982 |
| .84981 | .090604 | 1.85888E-2 | -4.32128E-2 | |
| -.255618 | -.264767 | .786968 | .911043 | .84981 |
| 1 | 3.32603E-2 | -.071448 | -.126346 | |
| -9.02595E-2 | -8.65845E-2 | .388404 | .315705 | .090604 |
| 3.32603E-2 | .999999 | .671952 | 8.20506E-3 | |
| -9.69874E-3 | 1.25337E-3 | .239571 | .259753 | 1.85888E-2 |
| -.071448 | .671952 | .999945 | -3.63959E-2 | |
| 4.12763E-2 | 6.77065E-2 | -3.20645E-2 | -.112159 | -4.32128E-2 |
| -.126346 | 8.20506E-3 | -3.63959E-2 | .999996 | |

| INDEX | MEANS | STANDARD DEVIATIONS | T. / 0 |
|-------|---------|---------------------|-------------------|
| 1 | 526.42 | 111.199 | |
| 2 | 527.249 | 111.334 | |
| 3 | 64.2354 | 7.69325 | |
| 4 | 61.3469 | 7.43691 | |
| 5 | 53.2231 | 5.26913 | MALES AND FEMALES |
| 6 | 51.4279 | 5.71229 | AGE 6-15 N = 390 |
| 7 | 120.135 | 4.32154 | |
| 8 | 116.377 | 5.73401 | |
| 9 | 12.7231 | 4.51621 | |

| CORRELATION COEFFICIENTS | | | | |
|--------------------------|-------------|-------------|-------------|------------|
| 1 | .994167 | -.192332 | -.185226 | -.188289 |
| -.191124 | -4.92761E-2 | -1.25133E-2 | -.188927 | |
| .994167 | .999999 | -.201243 | -.175227 | -.181445 |
| -.182424 | -3.97227E-2 | -3.25643E-2 | -.173283 | |
| -.192332 | -.201243 | .999996 | .839727 | .930244 |
| .779946 | .367229 | .258144 | -1.29634E-2 | |
| -.185226 | -.175227 | .839727 | .999993 | .794229 |
| .9344 | .312979 | .267224 | -.130699 | |
| -.188289 | -.181445 | .930244 | .794229 | .999987 |
| .831389 | 4.47672E-2 | .226324 | 2.75737E-2 | |
| -.191124 | -.182424 | .779946 | .9044 | .231389 |
| .999999 | 2.99242E-2 | -6.32253E-2 | -.095426 | |
| -4.92761E-2 | -3.97227E-2 | .367229 | .312979 | 4.47672E-2 |
| 2.99242E-2 | 1.00001 | .639551 | -.147293 | |
| -1.25133E-2 | -3.25643E-2 | .258144 | .267224 | .026324 |
| -6.32253E-2 | .639551 | .999999 | -.113154 | |
| -.185226 | -.175227 | -1.29634E-2 | -.130699 | 2.75737E-2 |
| -.9344 | -.147293 | -.113154 | 1 | |

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TABLE 1
DISTRIBUTION OF REFRACTIVE ERROR OF RIGHT AND LEFT EYES

| SEX | AGE | N | +7.00- | +2.25- | +1.25- | +0.25- | -0.25- | -1.25- | -2.75- |
|-----|------|-----|--------|--------|--------|--------|--------|--------|--------|
| | | | +2.37 | +1.37 | +0.37 | -0.12 | -1.12 | -2.62 | -6.00 |
| F | 6 | 118 | 4 | 4 | 61 | 30 | 17 | 2 | - |
| F | 7 | 32 | - | 2 | 26 | 4 | - | - | - |
| F | 8-13 | 10 | - | - | 4 | 5 | 1 | - | - |
| F | 14 | 170 | - | - | 61 | 57 | 45 | 4 | 3 |
| F | 15 | 36 | 8 | 2 | 11 | 4 | 7 | 4 | - |
| M | 6 | 132 | 4 | 7 | 71 | 36 | 14 | - | - |
| M | 7 | 48 | 2 | 7 | 25 | 12 | 2 | - | - |
| M | 8-13 | 30 | 2 | 2 | 13 | 8 | 4 | 1 | - |
| M | 14 | 158 | 2 | - | 41 | 50 | 37 | 15 | 13 |
| M | 15 | 46 | 6 | 2 | 14 | 2 | 19 | 3 | - |
| F | 6-15 | 366 | 12 | 8 | 163 | 100 | 70 | 10 | 3 |
| M | 6-15 | 414 | 16 | 18 | 164 | 108 | 76 | 19 | 13 |
| F&M | 6-15 | 780 | 28 | 26 | 327 | 208 | 146 | 29 | 16 |

TABLE 2

CORRELATION COEFFICIENTS BETWEEN REFRACTIVE ERROR,
PUPIL SIZE AND PUPIL:IRIS RATIO FOR FEMALE SUBJECTS

| AGE | N | PUPIL SIZE RIGHT EYE | PUPIL SIZE LEFT EYE | PUPIL:IRIS RIGHT EYE | PUPIL:IRIS LEFT EYE |
|-------|-----|-------------------------|------------------------|-------------------------|------------------------|
| 6 | 59 | -.338** | -.239 | -.331** | -.264 |
| 7 | 16 | .346 | .261 | .335 | .228 |
| 6-7 | 75 | -.246* | -.143 | -.249* | -.158 |
| 8-13 | 5 | .238 | .0308 | .0641 | -.125 |
| 14 | 85 | -.0249 | -.0292 | -.0112 | -.0004 |
| 15 | 18 | -.409 | -.600* | -.481 | -.661** |
| 14-15 | 103 | -.136 | -.186 | -.137 | -.181 |
| 6-15 | 183 | -.168* | -.153* | -.176** | -.174** |

TABLE 3

CORRELATION COEFFICIENTS BETWEEN REFRACTIVE ERROR,
PUPIL SIZE AND PUPIL:IRIS RATIO FOR MALE SUBJECTS

| AGE | N | PUPIL SIZE RIGHT EYE | PUPIL SIZE LEFT EYE | PUPIL:IRIS RIGHT EYE | PUPIL:IRIS LEFT EYE |
|-------|-----|-------------------------|------------------------|-------------------------|------------------------|
| 6 | 66 | -.0829 | -.0824 | -.0152 | -.0355 |
| 7 | 24 | -.0990 | -.296 | -.0773 | -.337 |
| 6-7 | 90 | -.0649 | -.111 | -.00871 | -.125 |
| 8-13 | 15 | -.103 | .150 | -.0238 | .396 |
| 14 | 79 | -.224* | -.258* | -.194 | -.291** |
| 15 | 23 | -.515* | -.438* | -.532** | -.395 |
| 14-15 | 102 | -.306** | -.311** | -.297** | -.327** |
| 6-15 | 207 | -.211** | -.192** | -.203** | -.196** |

TABLE 4

CORRELATION COEFFICIENTS BETWEEN REFRACTIVE ERROR,
PUPIL SIZE AND PUPIL:IRIS RATIO FOR MALE AND FEMALE SUBJECTS

| AGE | N | PUPIL SIZE RIGHT EYE | PUPIL SIZE LEFT EYE | PUPIL:IRIS RIGHT EYE | PUPIL:IRIS LEFT EYE |
|-------|-----|-------------------------|------------------------|-------------------------|------------------------|
| 6 | 125 | -.223* | -.166 | -.190* | -.148 |
| 7 | 40 | .0289 | -.151 | .0405 | -.203 |
| 6-7 | 165 | -.151* | -.150* | -.127 | -.155* |
| 8-13 | 20 | -.075 | .118 | .012 | .270 |
| 14 | 164 | -.147 | -.180* | -.108 | -.179* |
| 15 | 41 | -.444** | -.467** | -.478** | -.479** |
| 14-15 | 205 | -.229** | -.262** | -.217** | -.265** |
| 6-15 | 390 | -.192** | -.175** | -.188** | -.182** |

*significant at the .05 level ($p < 0.05$)

**significant at the .01 level ($p < 0.01$)

TABLE 5

COEFFICIENT OF DETERMINATION FOR CORRELATIONS
SIGNIFICANT AT THE .05 OR .01 LEVEL BETWEEN REFRACTIVE ERROR,
PUPIL SIZE AND PUPIL:IRIS RATIO FOR FEMALE SUBJECTS

| AGE | N | PUPIL SIZE RIGHT EYE | PUPIL SIZE LEFT EYE | PUPIL:IRIS RIGHT EYE | PUPIL:IRIS LEFT EYE |
|-------|-----|-------------------------|------------------------|-------------------------|------------------------|
| 6 | 59 | .114 | | .110 | |
| 7 | 16 | | | | |
| 6-7 | 75 | .061 | | .062 | |
| 8-13 | 5 | | | | |
| 14 | 85 | | | | |
| 15 | 18 | | .360 | | .437 |
| 14-15 | 103 | | | | |
| 6-15 | 183 | .028 | .023 | .031 | .030 |

TABLE 6

COEFFICIENT OF DETERMINATION FOR CORRELATIONS
SIGNIFICANT AT THE .05 OR .01 LEVEL BETWEEN REFRACTIVE ERROR,
PUPIL SIZE AND PUPIL:IRIS RATIO FOR MALE SUBJECTS

| AGE | N | PUPIL SIZE RIGHT EYE | PUPIL SIZE LEFT EYE | PUPIL:IRIS RIGHT EYE | PUPIL:IRIS LEFT EYE |
|-------|-----|-------------------------|------------------------|-------------------------|------------------------|
| 6 | 66 | | | | |
| 7 | 24 | | | | |
| 6-7 | 90 | | | | |
| 8-13 | 15 | | | | |
| 14 | 79 | .050 | .067 | | .085 |
| 15 | 23 | .265 | .192 | .283 | |
| 14-15 | 102 | .094 | .097 | .088 | .107 |
| 6-15 | 207 | .045 | .037 | .041 | .038 |

TABLE 7

COEFFICIENT OF DETERMINATION FOR CORRELATIONS
SIGNIFICANT AT THE .05 OR .01 LEVEL BETWEEN REFRACTIVE ERROR,
PUPIL SIZE AND PUPIL:IRIS RATIO FOR MALE AND FEMALE SUBJECTS

| AGE | N | PUPIL SIZE RIGHT EYE | PUPIL SIZE LEFT EYE | PUPIL:IRIS RIGHT EYE | PUPIL:IRIS LEFT EYE |
|-------|-----|-------------------------|------------------------|-------------------------|------------------------|
| 6 | 125 | .050 | | .036 | |
| 7 | 40 | | | | |
| 6-7 | 165 | .023 | .023 | | .024 |
| 8-13 | 20 | | | | |
| 14 | 164 | | .032 | | .032 |
| 15 | 41 | .197 | .218 | .228 | .229 |
| 14-15 | 205 | .052 | .069 | .047 | .070 |
| 6-15 | 390 | .037 | .031 | .035 | .033 |

TABLE 8
MEAN AND STANDARD DEVIATION VALUES
OF PUPIL SIZE AND PUPIL:IRIS RATIO FOR FEMALE SUBJECTS

| AGE | N | PUPIL SIZE | | PUPIL SIZE | | PUPIL:IRIS | | PUPIL:IRIS | |
|-------|-----|------------|------|------------|------|------------|------|------------|------|
| | | RIGHT EYE | | LEFT EYE | | RIGHT EYE | | LEFT EYE | |
| | | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. |
| 6 | 59 | 6.3 | .8 | 6.2 | .8 | .52 | .06 | .51 | .06 |
| 7 | 16 | 6.4 | .8 | 6.3 | .7 | .53 | .06 | .52 | .05 |
| 6-7 | 75 | 6.4 | .8 | 6.2 | .7 | .52 | .06 | .52 | .06 |
| 8-13 | 5 | 6.7 | .6 | 6.3 | .6 | .56 | .05 | .53 | .06 |
| 14 | 85 | 6.4 | .9 | 6.0 | .8 | .53 | .07 | .51 | .07 |
| 15 | 18 | 6.3 | .7 | 6.0 | .7 | .53 | .05 | .51 | .08 |
| 14-15 | 103 | 6.4 | .8 | 6.0 | .8 | .53 | .07 | .51 | .07 |
| 6-15 | 183 | 6.3 | .9 | 6.1 | .8 | .53 | .06 | .51 | .06 |

TABLE 9
MEAN AND STANDARD DEVIATION VALUES
OF PUPIL SIZE AND PUPIL:IRIS RATIO FOR MALE SUBJECTS

| AGE | N | PUPIL SIZE | | PUPIL SIZE | | PUPIL:IRIS | | PUPIL:IRIS | |
|-------|-----|------------|------|------------|------|------------|------|------------|------|
| | | RIGHT EYE | | LEFT EYE | | RIGHT EYE | | LEFT EYE | |
| | | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. |
| 6 | 66 | 6.4 | .6 | 6.2 | .6 | .52 | .05 | .51 | .05 |
| 7 | 24 | 6.6 | .7 | 6.3 | .6 | .54 | .05 | .52 | .06 |
| 6-7 | 90 | 6.4 | .6 | 6.2 | .6 | .53 | .05 | .51 | .05 |
| 8-13 | 15 | 6.5 | .6 | 6.2 | .6 | .53 | .05 | .52 | .04 |
| 14 | 79 | 6.5 | .8 | 6.1 | .7 | .53 | .06 | .51 | .06 |
| 15 | 23 | 6.3 | .9 | 6.0 | 1.0 | .52 | .07 | .50 | .07 |
| 14-15 | 102 | 6.4 | .8 | 6.1 | .8 | .53 | .06 | .51 | .07 |
| 6-15 | 207 | 6.5 | .7 | 6.2 | .7 | .53 | .06 | .51 | .06 |

TABLE 10
MEAN AND STANDARD DEVIATION VALUES
OF PUPIL SIZE AND PUPIL:IRIS RATIO FOR MALE AND FEMALE SUBJECTS

| AGE | N | PUPIL SIZE | | PUPIL SIZE | | PUPIL:IRIS | | PUPIL:IRIS | |
|-------|-----|------------|------|------------|------|------------|------|------------|------|
| | | RIGHT EYE | | LEFT EYE | | RIGHT EYE | | LEFT EYE | |
| | | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. |
| 6 | 125 | 6.3 | .7 | 6.2 | .7 | .53 | .05 | .52 | .05 |
| 7 | 40 | 6.6 | .7 | 6.3 | .7 | .54 | .05 | .52 | .05 |
| 6-7 | 165 | 6.4 | .7 | 6.2 | .7 | .53 | .05 | .52 | .05 |
| 8-13 | 20 | 6.6 | .6 | 6.2 | .6 | .54 | .05 | .52 | .04 |
| 14 | 164 | 6.4 | .8 | 6.1 | .8 | .54 | .07 | .51 | .06 |
| 15 | 41 | 6.3 | .8 | 6.0 | .9 | .52 | .06 | .50 | .06 |
| 14-15 | 205 | 6.4 | .8 | 6.1 | .8 | .53 | .06 | .51 | .06 |
| 6-15 | 390 | 6.4 | .8 | 6.1 | .7 | .53 | .06 | .51 | .06 |

TABLE 11
MEAN AND STANDARD DEVIATION VALUES
FOR REFRACTIVE ERROR AND IRIS DIAMETER FOR FEMALE SUBJECTS

| AGE | N | REFRACTIVE ERROR | | | | IRIS DIAMETER | | | |
|-------|-----|------------------|------|----------|------|---------------|------|----------|------|
| | | RIGHT EYE | | LEFT EYE | | RIGHT EYE | | LEFT EYE | |
| | | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. |
| 6 | 59 | +0.48 | .84 | +0.50 | .75 | 12.0 | .4 | 11.7 | .6 |
| 7 | 16 | +0.67 | .38 | +0.68 | .41 | 12.1 | .5 | 11.5 | .4 |
| 6-7 | 75 | +0.52 | .77 | +0.54 | .70 | 12.0 | .4 | 11.7 | .6 |
| 8-13 | 5 | +0.30 | .45 | +0.10 | .42 | 12.1 | .1 | 11.8 | .2 |
| 14 | 85 | +0.02 | .64 | +0.05 | .62 | 11.9 | .5 | 11.5 | .6 |
| 15 | 18 | +1.00 | 2.12 | +0.96 | 1.97 | 11.9 | .3 | 11.5 | .5 |
| 14-15 | 103 | +0.20 | 1.11 | +0.21 | 1.03 | 11.9 | .5 | 11.5 | .6 |
| 6-15 | 183 | +0.34 | .98 | +0.35 | .91 | 12.0 | .5 | 11.6 | .6 |

TABLE 12
MEAN AND STANDARD DEVIATION VALUES
FOR REFRACTIVE ERROR AND IRIS DIAMETER FOR MALE SUBJECTS

| AGE | N | REFRACTIVE ERROR | | | | IRIS DIAMETER | | | |
|-------|-----|------------------|------|----------|------|---------------|------|----------|------|
| | | RIGHT EYE | | LEFT EYE | | RIGHT EYE | | LEFT EYE | |
| | | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. |
| 6 | 66 | +0.52 | .74 | +0.55 | .71 | 12.1 | .5 | 11.8 | .6 |
| 7 | 24 | +0.82 | .77 | +0.80 | .81 | 12.2 | .4 | 11.7 | .5 |
| 6-7 | 90 | +0.60 | .76 | +0.61 | .75 | 12.2 | .5 | 11.7 | .5 |
| 8-13 | 15 | +0.47 | 1.03 | +0.41 | 1.77 | 12.0 | .7 | 11.6 | .7 |
| 14 | 79 | +0.36 | 1.37 | +0.35 | 1.38 | 12.0 | .5 | 11.6 | .5 |
| 15 | 23 | +0.39 | 1.52 | +0.41 | 1.44 | 12.0 | .5 | 11.8 | .5 |
| 14-15 | 102 | +0.19 | 1.43 | +0.18 | 1.42 | 12.0 | .5 | 11.7 | .5 |
| 6-15 | 207 | +0.20 | 1.22 | +0.21 | 1.26 | 12.1 | .5 | 11.7 | .6 |

TABLE 13
MEAN AND STANDARD DEVIATION VALUES
FOR REFRACTIVE ERROR AND IRIS DIAMETER FOR MALE AND FEMALE SUBJECTS

| AGE | N | REFRACTIVE ERROR | | | | IRIS DIAMETER | | | |
|-------|-----|------------------|------|----------|------|---------------|------|----------|------|
| | | RIGHT EYE | | LEFT EYE | | RIGHT EYE | | LEFT EYE | |
| | | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. | MEAN | S.D. |
| 6 | 125 | +0.50 | .79 | +0.52 | .73 | 12.1 | .4 | 11.7 | .6 |
| 7 | 40 | +0.76 | .64 | +0.76 | .68 | 12.1 | .4 | 11.6 | .5 |
| 6-7 | 165 | +0.57 | .76 | +0.58 | .72 | 12.1 | .4 | 11.7 | .5 |
| 8-13 | 20 | +0.43 | .91 | +0.33 | 1.53 | 12.0 | .6 | 11.7 | .6 |
| 14 | 164 | +0.16 | 1.07 | +0.14 | 1.07 | 11.9 | .5 | 11.6 | .6 |
| 15 | 41 | +0.66 | 1.81 | +0.65 | 1.69 | 12.0 | .5 | 11.6 | .5 |
| 14-15 | 205 | .00 | 1.29 | +0.02 | 1.26 | 11.9 | .5 | 11.6 | .6 |
| 6-15 | 390 | +0.26 | 1.11 | +0.27 | 1.11 | 12.0 | .5 | 11.6 | .6 |

TABLE 14
SUMMARY OF CORRELATION COEFFICIENTS FOR MALE AND FEMALE SUBJECTS

| | R.E. RIGHT | R.E. LEFT | PUPIL RIGHT | PUPIL LEFT | P:IRIS RIGHT | P:IRIS LEFT | IRIS RIGHT | IRIS LEFT | AGE |
|--------------------------|---------------|--------------|----------------|---------------|-----------------|----------------|---------------|--------------|--------|
| R.ERROR RIGHT EYE | 1 | .894 | -.192 | -.185 | -.188 | -.191 | .0493 | .0125 | -.189 |
| R.ERROR LEFT EYE | .894 | 1 | -.202 | -.175 | -.181 | -.182 | .0897 | .0325 | -.178 |
| PUPIL SIZE RIGHT EYE | -.192 | -.202 | 1 | .840 | .930 | .780 | .367 | .258 | -.0130 |
| PUPIL SIZE LEFT EYE | -.185 | -.175 | .840 | 1 | .794 | .904 | .313 | .267 | -.130 |
| PUPIL: IRIS RIGHT EYE | -.188 | -.181 | .930 | .794 | 1 | .831 | .0450 | .0268 | .0276 |
| PUPIL: IRIS LEFT EYE | -.191 | -.182 | .780 | .904 | .831 | 1 | .0300 | .0682 | .0954 |
| IRIS RIGHT EYE | -.0493 | -.0897 | .367 | .313 | -.048 | -.0300 | 1 | .690 | -.148 |
| IRIS LEFT EYE | -.0125 | -.0326 | .258 | .267 | .027 | -.0682 | .690 | 1 | -.113 |
| AGE | -.189 | -.178 | -.0130 | -.131 | -.0276 | -.0954 | -.148 | -.113 | 1 |

NOTE: With an N of 390, a correlation greater than .10 is significant at the 5% level; a correlation greater than .130 is significant at the 1% level.

TABLE 15
SUMMARY OF CORRELATION COEFFICIENTS FOR FEMALE SUBJECTS

| | R.E. RIGHT | R.E. LEFT | PUPIL RIGHT | PUPIL LEFT | P:IRIS RIGHT | P:IRIS LEFT | IRIS RIGHT | IRIS LEFT | AGE |
|-------------------------|---------------|--------------|----------------|---------------|-----------------|----------------|---------------|--------------|-------|
| R. ERROR RIGHT EYE | 1 | .937 | -.169 | -.149 | -.176 | -.161 | .043 | .003 | -.121 |
| R. ERROR LEFT EYE | .937 | 1 | -.187 | -.153 | -.188 | -.174 | .040 | .017 | -.106 |
| PUPIL SIZE RIGHT EYE | -.169 | -.187 | 1 | .849 | .942 | .801 | .355 | .192 | .012 |
| PUPIL SIZE LEFT EYE | -.149 | -.153 | .849 | 1 | .820 | .906 | .313 | .206 | -.158 |
| PUPIL:IRIS RIGHT EYE | -.176 | -.188 | .941 | .819 | 1 | .850 | .0638 | -.014 | .033 |
| PUPIL:IRIS LEFT EYE | -.161 | -.174 | .801 | .906 | .850 | 1 | .049 | -.125 | -.117 |
| IRIS RIGHT EYE | .0428 | .0403 | .355 | .313 | .0638 | .049 | 1 | .701 | -.119 |
| IRIS LEFT EYE | .003 | .017 | .192 | .206 | -.0135 | -.125 | .701 | 1 | -.134 |
| AGE | -.121 | -.106 | .0115 | -.158 | .033 | -.117 | -.119 | -.134 | 1 |

NOTE: With an N of 183, a correlation greater than .159 is significant at the 5% level; a correlation greater than .208 is significant at the 1% level.

TABLE 16
SUMMARY OF CORRELATION COEFFICIENTS FOR MALE SUBJECTS

| | R.E. RIGHT | R.E. LEFT | PUPIL RIGHT | PUPIL LEFT | P:IRIS RIGHT | P:IRIS LEFT | IRIS RIGHT | IRIS LEFT | AGE |
|-------------------------|---------------|--------------|----------------|---------------|-----------------|----------------|---------------|--------------|-------|
| R. ERROR RIGHT EYE | 1 | .873 | -.212 | -.212 | -.203 | -.220 | -.098 | -.012 | -.271 |
| R. ERROR LEFT EYE | .873 | 1 | -.217 | -.192 | -.184 | -.196 | -.156 | -.055 | -.260 |
| PUPIL SIZE RIGHT EYE | -.212 | -.217 | 1 | .830 | .919 | .759 | .376 | .321 | -.038 |
| PUPIL SIZE LEFT EYE | -.212 | -.192 | .830 | 1 | .769 | .905 | .311 | .323 | -.097 |
| PUPIL:IRIS RIGHT EYE | -.203 | -.184 | .919 | .769 | 1 | .811 | .026 | .069 | .021 |
| PUPIL:IRIS LEFT EYE | -.220 | -.196 | .759 | .905 | .811 | 1 | .015 | -.009 | -.07 |
| IRIS RIGHT EYE | -.10 | -.156 | .376 | .311 | .026 | .0150 | 1 | .674 | -.171 |
| IRIS LEFT EYE | -.012 | -.055 | .321 | .323 | .069 | -.001 | .674 | 1 | -.077 |
| AGE | -.271 | -.260 | -.039 | -.10 | .021 | -.069 | -.171 | -.077 | 1 |

NOTE: With an N of 207, a correlation greater than .138 is significant at the 5% level; a correlation greater than .181 is significant at the 1% level.