12-1981

Effects of a selected motor skill task on the development of stereopsis

William M. Rentschler
University of Nebraska at Omaha

EFFECTS OF A SELECTED MOTOR SKILL TASK ON THE DEVELOPMENT OF STEREOPSIS

A Thesis

Presented to the

School of Health, Physical

Education, and Recreation

and the

Faculty of the Graduate College

University of Nebraska

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

University of Nebraska at Omaha

by

William M. Rentschler

December, 1981

THESIS ACCEPTANCE

Accepted for the faculty of the Graduate College, University of Nebraska, in partial fulfillment of the requirements for degree Master of Arts, University of Nebraska at Omaha.

THESIS COMMITTEE

NAME	DEPARTMENT
Larry M. Albertson	Teacher Education
Larry Stephen	Math/CS
Kris Berg	HPER

Larry M. Albertson
Chairman

December 4, 1981
DATE

ACKNOWLEDGMENTS

I would like to thank the committee members, Dr. Larry Stephens and Dr. Kris Berg for the time, effort and guidance they have given in this project; and Chairperson, Dr. Larry Albertson, for his continued support and advice that made this paper possible.

I would like to acknowledge the technical assistance and advice of Fran Pantano of the University of Nebraska Opthalmology Clinic and Gayle Olson for her typing assistance.

A special thanks to my wife, Kathy Rentschler, who has supported me throughout my academic endeavors including all the trials and tribulations of a thesis paper.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

ANALYSIS OF THE PROBLEM

Introduction

One would expect visual-perceptual abilities to be quite important in sport skills. Donna Mae Miller (1960) substantiated this idea when she examined a battery of eight tests she felt were important in responding quickly and accurately to visual cues. Highly skilled athletes scored considerably higher in areas of static balance, stereopsis, blocks response and mutilated words than did lower skilled athletes. Williams (1968) in a similar study looked at visual-perceptual judgments in a more dynamic approach. Subjects were asked to catch tennis balls after they had been projected into the air and bounced off of a canvas. The results found highly skilled performers significantly superior in visual perception to individuals classified as poorly skilled.

In the study conducted by Miller (1960) the correlation between champion and near champion athletes and the static balance test was $r=0.507$ ($p \leq .01$), the depth perception test $r=0.194$ ($p \leq .05$) and finally with the blocks response test $r=0.245$ ($p \leq .01$). Low intercorrelations were found among all the tests except for high correlations between depth perception and static balance which may indicate some common visual element.

Since the static balance test correlated so strongly with high skill and with the significant relationship that exists between balance and depth perception, the question whether depth perception is innate or acquired becomes an important consideration. Are athletes highly skilled because of a depth perception proficiency they already have or has the nature of their activity been able to increase this perception?

Statement of the Problem

The purpose of this study was to see if stereopsis increases with training.

Assumptions

The following is an assumption upon which this investigation was based:

1. The Titmus and Random Dot methods are accurate methods of measuring stereoacuity.

Hypothesis

The hypothesis stated in the null form was: stereopsis will not improve as a result of daily use of the Lafayette device.

Delimitations/Limitations

The subjects of the study were 10 boys and 8 girls who ranged in age from 4 to 7 years of age. All subjects were participating in the gifted children's program sponsored by the School of Health, Physical Education and Recreation at the University of Nebraska at Omaha during the summer of 1981. An Air Force depth perception device (Lafayette Instrument Co., Lafayette, Indiana, Model #14012) was used as the treatment mode for the experimental group. Limitations in the study included the small number of subjects and the duration of the study.

Definition of Terms

Astigmatism - An error of refraction where parallel light rays fail to focus on the retina (Miller, B., Keane, 1972).

Binocular Single Vision - A process of sensory fusion where single vision is achieved from two similar but disparate retinal images (Moses, [Ed.], 1975).

Disparate Retinal Receptors - Receptors having slightly different visual directions (Moses, [Ed.], 1975).

Panum's Fusional Area - Describes the area located on the retina where for "any point on one retina there is a small circle or area of points on the other retina stimulation of which will lead to fusion of the two monocular inputs" (Moses, [Ed.], 1975).

Seconds of Arc - The angle of retinal disparity.

Stereopsis - One's ability to perceive objects as three dimensional or to recognize the relative distances to different objects in space (Miller, B., Keene, 1972; Dorland, 1974).

Strabismus - A deviation in the eye in which the visual areas are not physiologically coordinated; also called cross-eyes and squint (Miller, B., Keane, 1972).

Visual-Perception - A series of sensory events that begin as an object or event in the periphery and ends as an event in the brain of the individual. (Williams, 1968).

CHAPTER II

REVIEW OF RELATED LITERATURE

Physiology of Stereopsis

As described in the previous chapter, visual perception is a series of sensory events that begins as an object or event in the periphery and ends as as event in the brain of the individual. Depth perception or stereopsis on the other hand is one's ability to perceive objects as three dimensional or to recognize the relative distances to different objects in space.

Depth is perceived by the use of monocular and binocular cues (Kawabata and Kiyoshi, 1977). Monocular or single vision cues would include things as object overlay, linear and aerial perspective, light areas, shadows and texture. Also, monocular cues would be considered secondary cues to that of binocular disparity (Moses, [Ed.], 1975).

Stereopsis due to binocular cues is due to the viewing of an object from two different retinal vantage points (Moses, [Ed.], 1975). This is because of the horizontal separation of the eyes and is also the reason that as the horizontal disparity within the eye increases greater depth is perceived.

This retinal disparity will take a visual pathway through the right and left optic nerve, combine into one optic chiasm and lead to what is felt to be binocular disparity cells within the brain (Moses, [Ed.], 1975). Westheimer and McKee (1979) further clarify that it is not the separation of the two eyes but the resultant disparity that allows for depth values.

Fiorentini (1970) states that neurons have been found in the visual cortex of a cat which were primarily activated when both of the eyes were stimulated by equal stimuli in two non-corresponding areas of the retina. These neurons have been construed to be responsible for binocular depth perception.

Petigrew (1978) quoted similar findings regarding the cat neurons but also discussed P. Clarke Lausanne's work on the visual cortex of sheep. He had found that within the visual area there were possibly three separate groups of disparity selective neurons grouped in clusters or columns. These different clusters of neurons preferred targets nearer than, farther than and centered on the fixation plane. These disparity selective neurons were evidently found in the visual area of young lambs who had no prior visual experience and would therefore support the viewpoint that the basic machinery for depth perception is innate. One class of these binocular neurons which are termed "AND" gates is not found however in these lambs. These "AND" gate neurons are particularly sensitive to experience. It is evident then that visual experience is important in the development of these clusters. This gives credence to an acquired level of depth perception.

Danta (1978) agrees with Petigrew and goes on to say he feels these neural mechanisms in areas outside the normal visual areas play an important role in normal stereopsis. Visual depth perception does not seem to depend on the integrity of a unitary brain mechanism localized within a particular area of one hemisphere but rather on the organization of a number of discrete but functionally interrelated neural mechanisms which may involve widespread areas of the brain.

Subhash (1966) tested for stereoscopic acuity to see if there was a relationship between age and stereopsis failure. He did indeed find that a relationship existed ($p=0.001$); after the development of stereopsis, the older one was, the greater the percent of failures on the test. The test employed was called a siastereo test which employed a flashlight type apparatus on which there were three dots in a triangular shape, one of which appeared closer than the other two. Passing the test required four correct answers out of four trials. The dots were such that anyone possessing stereoscopic vision could easily distinguish which was closer. The youngest age groups were combined into a 0 to 9 years of age category. There were 8.9%

failures out of 146 tested. This was the greatest failure rate till the 50 to 59 year range.

Johnson and Bech (1941) did a study where they attempted to isolate the age at which children begin to perceive depth. They tested the children using a projector with a type of prism attached that, when in place, made an image of a doll appear to come out from the plane of the screen to somewhere approximately 10 inches in front of the screen. It was necessary for the children to wear polarized glasses. A total of 23 children were tested. There were 6 two-year-olds, 4 three-year-olds, 7 four-year-olds, 4 five-year-olds, and 2 six-year-olds. The testers would ask the subjects if they would like to touch the dolly. Their responses and where they tried to grasp were recorded. The authors felt all of the subjects localized the doll somewhere 10-12 inches in front of the screen. From this they theorized that by as young as two years of age stereoscopic vision was developed.

Carr (1935) tested 11 children ages 3 to 5 years. The test consisted of identifying the closest of a stereoscopic diagram of three objects. The 3 year-olds made 15 errors in 72 identifications, the 4 year-olds gave 40 correct out of 48 and the 5 year-olds gave 35 correct out of 36. He concluded that the mechanism for stereopsis was present by three years of age and improves with increasing age.

Testing for Stereopsis

Julesy (1971) found approximately 15% of the population deficient in stereopsis. Some of these showed an uncorrected astigmatism which, when corrected, improved stereopsis greatly. Hugonnier and Huggonier (1969) stated that it is useless to look for stereoscopic vision in untreated strabismus as it is always absent.

Many tests have been devised to examine the proficiency of stereopsis. Some differences have been found to occur concerning when stereopsis begins to develop and also when it is fully developed.

The obvious difficulty in testing very young children is devising a test that will elicit a cooperative response. Tables whose tops are constructed of glass are a favorite of many examiners in testing very young prelocomotor children. One side gives the illusion of shallowness while the other appears to drop off deeply. Infants are cardiac monitored to test their responses. Campos et al. (1970) in using a similar test concluded that by at least the time locomotion is possible evidence of perceiving depth is present.

Recently a new method was developed by Fox et al.(1980). They produced color television film that, when viewed through red and green filters, enabled the subject to see an object and to watch it move to the left or right. Only if stereopsis was present could they see the object. From this point it would be a simple matter to watch very young children to see if their eyes tracked the objects in the film. From these tests he concluded that somewhere between 3½ to 6 months of age stereopsis began to emerge.

The Titmus (or Wirt) Stereo Test is perhaps the most widely used test for stereopsis (Frisby, 1975). The test comes in booklet form and is divided into three sections. There are three sections made up of cartoon characters, circles and a large fly subtest. The subtests are developed so they are progressively more difficult to discriminate. Although widely used, critics claim that they provide additional monocular cues that are not found on some other tests on the market.

Random Dot stereograms have also been developed as a means to measure stereopsis. A characteristic feature of using random dot stereograms is that it provides disparity cues to depth in an extremely pure form (Frisby, 1975). Monocular cues which might be present in other tests are not found when using random dot stereograms.

Romano et al. (1975) tested 321 children using the Titmus method. The subjects progressed from 3000 seconds of arc at ages 3½ - 5 years, 140 seconds of arc at 5 - 5½ years, 100 seconds of arc at 5½ - 6 years, 80 seconds of arc at 6 - 7 years, 60 seconds of arc at 7 - 9 years and after 9 years was essentially developed at 40 seconds of arc. Pantano (1979) with a similar study using 3, 4 and 5 year olds essentially agreed, but the 5 year olds ranged from 80 seconds to 140 seconds of arc.

Summary of Literature Review

Depth is perceived by means of monocular and binocular cues. In depth perception the more important binocular cues are formed as we observe an object from two different points of view, the different points coming from the separation of our eyes and the resultant image falling on similar but disparate points on each retina. If an image point on one retina falls within a small area on the other retina (i.e., Panum's fusional area), the image will fuse and result in single binocular vision. As the images on the two retinas become more disparate, greater depth will be stimulated.

Neurons have been found in both cat and sheep that are felt to be responsible for depth perception. Some of these neurons were found in baby lambs that had no prior visual experience which supported the idea that stereopsis is innate. However "AND" gate neurons which are particularly sensitive to experience were not found. This fact could support visual experience as important in the development of depth perception and give credence to an acquired level of depth perception. These neurons do not appear to be localized within any one hemisphere but rather may involve wide areas of the brain.

Approximately 15% of the population is deficient in stereopsis. A portion of these are due to disorders of the eyes such as astigmatism and strabismus.

Many tests have been devised to test stereopsis. The most common test is the Titmus Stereo Test. Since this test provides additional monocular cues, the Random Dot Test was developed which provides disparity cues to depth in an extremely pure form.

There are differences in the literature regarding how stereopsis develops. As early as 3½ to 6 months, stereopsis appears to be developing. Recent studies by Romano et al. (1975) and by Pantano (1979) used the Titmus method to test stereopsis. Their findings indicate that 5 to 6 year olds could have a range of 80 to 140 seconds of arc.

CHAPTER III

PROCEDURES

The study was undertaken to determine if stereopsis could be improved with training. The procedures used are described in this chapter.

Subjects

The subjects participating in this study were twenty boys and girls who ranged in age from four to seven years. The mean age of the control group was 72.9 months as compared to 66.8 months for the experimental group. All children were participating in the Gifted Children's Program in the School of Health, Physical Education and Recreation Building at the University of Nebraska at Omaha during the summer of 1981.

Instrumentation

The following equipment was used in this investigation:

1. Lafayette Depth Perception Device (Lafayette Instrument Company, Model #14012)

2. Randot Stereo Tests (Stereo Optical Company, Inc.)

   a. Random Dot Test
   b. Titmus Test

Testing Procedure

All subjects were randomly divided into a control and an experimental group. On the first day of the summer program, the children were individually taken to a well-lit room for testing. The three tests administered were the Titmus, Random Dot and Lafayette device. The order in which the tests were administered was randomized for each subject. In both the Titmus and the Random Dot tests, the subjects were allowed one miss at which point the examiner backed up two questions and proceded again. The next time the subject missed, the highest number correct was recorded as the score. The test booklets were held approximately 16 inches from the subject and polarizing glasses were worn. After an explanation of the tests, minimal prompting was given. Between tests, subjects were told they were doing well.

The third test was a Lafayette Depth Perception Device. It consisted of a lighted rectangular box in which two black rods can be moved forwards or backwards parallel to each other by a string, each end of which is attached to the rods themselves. The subjects were taken to the box and shown how the rods could be moved. At close range the subjects viewed the starting position, with the right rod completely to the back and the left rod completely to the front. Movement of the rods to the desired position parallel to each other was also shown. The subjects were taken to the end of the string approximately 20 feet from the box and asked to move the rods so they "look like they are next to each other". After each trial, the subjects were taken to the box and shown the results. Three trials were given and the mean recorded as the score. The tests were readministered during the next to last day of the program in the same manner as the pretest. See Table 1 for a summary of the treatment groups.

Treatment

Subjects in the experimental group were taken daily from their activities to a separate room and administered the Lafayette test. Three trials were given and the mean score recorded daily. Verbal encouragement and praise were given for good results. The experimental group received a total of thirteen trial days before the post-test was administered. Trial days were consecutive following the pre-test, which was on a Monday, but did not include Saturdays or Sundays.

Two of the original twenty subjects were dropped from the study, one from each of the two groups. As a result, only eighteen subjects were included in the study.

TABLE 1

Summary of Treatment Groups

	Group #1 (Control)	Group #2 (Experimental)
Titmus	Pre & Post Test	Pre & Post Test
Random Dot	Pre & Post Test	Pre & Post Test
Lafayette	Pre & Post Test	Pre & Post Test & Daily Use

Analysis of Data

Due to the variability of the pre-test scores, it was decided to perform an analysis of covariance comparing the control and experimental groups for all three tests. The pre-test score was the covariate and the post-test score was the variable of interest. The assumption of parallelism of the regression lines was established on the Lafayette and Titmus tests (See Tables 2 and 3 for results). The assumption of parallelism was not met on the Random Dot Test and, therefore, a Two sample T-test was used to determine significance.

CHAPTER IV

ANALYSIS OF DATA

RESULTS

The F-ratios in the analysis of covariance for both the Titmus (Table 2) and Lafayette tests (Table 3) were not significant. The t-value of the pooled variance estimated for the Random Dot test was also not significant. We are unable to reject the null hypothesis of no difference in the experimental and control group for any of the three tests.

DISCUSSION

The consistently high pre and post scores had not been anticipated in this study. Romano et al. (1975) using the Titmus method had scores from 140 seconds of arc at 5 - 5½ years and 80 seconds of arc at 6 - 7 years. Pantano (1979) in a similar type of study had only slightly lower values with the 5 year-olds ranging from 80 to 140 seconds of arc.

In this study using gifted children, the average age of all the participants was 69 months. The average pre score of either the Titmus or Random Dot test in both groups was below 30 seconds of arc. With the consistently low pre-test scores it would have been difficult to show any significant increase in depth perception. This, in fact, was the case; no significant increase in depth perception was found in the control or experimental group.

Several factors may have been involved in obtaining these results. Probably the most obvious would be the selection of the population. Romano et al. (1975) and Pantano (1979) used a "normal" population while this study utilized a "gifted" population. One might speculate then that whatever factors are related to making one "gifted" may also be factors in the development of stereopsis.

A larger sample size would have been desirable for this study. To obtain the standard error of the mean the standard deviation is divided by the square root of the sample size minus 1. The standard deviation of each group is relatively high while the sample size is small. This will tend to give higher values for the standard error of the mean (See Table 4 & 5). High values here will detract from the significance of the results. It is the author's belief that additional subjects would only have shown further low scores on the tests.

The length and duration of the training sessions are important considerations; however, the close to maximal pre-scores obtained in this study diminish this importance. If higher pre-score values were obtained by either a "normal" population or younger "gifted" children, a longer treatment period may have influenced significance. Practice trials during each session may also have been a factor that could be increased.

TABLE 2

Summary of Ancova for Titmus Test

Source of Variation	SS	DF	MS	F-Ratio
Covariate (pre-Titmus)	1549.439	1	1549.439	7.536
Groups	10.805	1	10.805	.053
Explained	1560.244	2	780.122	3.794
Residual	3084.201	15	205.613	
TOTAL	4644.444	17	273.202	

TABLE 3

Summary of Ancova for Lafayette Test

Source of Variation	SS	DF	MS	F-Ratio
Covariate (pre-Lafayette)	2.176	1	2.176	2.373
Groups	.702	1	.702	.765
Explained	2.877	2	1.439	1.569
Residual	13.754	15	.917	
TOTAL	16.631	17	.978	

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

P. Clarke Lausanne as cited by Petigrew (1978) did work on the visual cortex of sheep and felt one of three types of binocular neurons termed "AND" gates are sensitive to experience. The purpose of this investigation was to see if depth perception could be improved by practice with a Lafayette Depth Perception Device.

Two groups were randomly selected from a summer gifted children's program. Pre- and post-tests of depth perception were done using the Titmus and Random Dot methods. The control group continued with the program without further treatment while the experimental group received practice Monday thru Friday for thirteen sessions. The results showed no significant difference between the two groups.

Conclusions

The following conclusion is warranted as a result of the study:

1. Stereopsis will not change significantly as a result of practice with the Lafayette device.

Recommendations

The following recommendations for additional study seem warranted:

1. A similar study using children drawn from a "normal" population.
2. A study using children younger than the ones used in this study.
3. A similar study using a larger number of subjects.
4. A study applying the treatment over a longer period of time.
5. A study comparing the development of stereopsis in "normal" and "gifted" populations.

SELECTED BIBLIOGRAPHY

Campos, Joseph, Alan Langer, and Alice Krowitz. 1980. "Cardiac Responses on the Visual Cliff in Prelocomotor Human Infants." Science, 170:196-7, Oct.

Carr, Harvey A., 1935. An Introduction to Space Perception. New York, London, Toronto: Longmans, Green and Co.

Danta, G., R.C. Hilton, and D.J. O'Boyle. 1978. "Binocular Depth Perception," Brain, 101(4):569-89, Dec.

Dorlands' Illustrated Medical Dictionary (25th ed.). 1974. Phil, London, Toronto: W.B. Saunders

Fiorentini, Adriana, and Maffei Lamberto. 1970. "Electro-Physiological Evidence for Binocular Disparity Detectors in Human Visual System," Science, 169:208-9, July.

Fox, Robert, Richard Aslin, Sandra Shea, and Susan Dumais. 1980. "Stereopsis in Human Infants," Science, 207:323, Jan.

Frisby, John P. 1975. "Random-dot Stereograms for Clinical Assessment of Stereopsis in Children," Developmental Medicine and Child Neurology, 17:802-5.

Huggonier, Rene', and Suzanne Clayette Huggonier. 1969. Strabismus, Heterophoria, Ocular Motor Paralysis. St. Louis: The C.V. Mosby Company.

Johnson, Beth, and L.F. Beck. 1941. "The Development of Space Perception: Stereoscopic Vision in Preschool Children," The Journal of Genetic Psychology, 68:247-254.

Julesy, Bela. 1971. Foundations of Cyclopean Perception. Chicago and London: The University of Chicago Press.

Kawabata, Nobuo, and Kiyoshi Yamagami. 1977. "Visual Fixation Points and Depth Perception," Vision Research, 18:853-4.

Miller, Benjamin F., and Claire Brackman Keane. 1972. Encyclopedia and Dictionary of Medicine and Nursing. Phil, London, and Toronto: W.B. Saunders Co.

Miller, Donna Mae. 1960. "The Relationship Between Some Visual Perceptual Factors and the Degree of Success Realized by Sports Performers." Ph.D. dissertation, University of Southern California.

Moses, Robert A., ed. 1975. Adler's: Physiology of the Eye. 6th ed. Saint Louis: The C.V. Mosby Co.

Ott, Lyman. 1977. An Introduction to Statistical Methods and Data Analysis. North Scituate, Massachusetts: Duxbury Press.

Pantano, Frances M. 1979. "A Comparative Survey of Preschool Stereopsis: Titmus Versus TNO," Ophthalmology, 86:2134-2139, Dec.

Petigrew, J. 1978. "Stereoscopic Visual Processing," Nature, 273:9-11, May.

Romano, Paul E., Judith A. Romano, and James E. Puklin. 1975. "Stereoacuity Development in Children with Normal Binocular Single Vision," American Journal of Opthalmology, 79(6):966-971, June.

Slonim, Philip S., Seymour Weissman, Esta Glazer, and Patricia A. Nettler. 1975. "Effects of Training on Dynamic Stereo Acuity Performance by Males and Females," Perceptual and Motor Skills, 40:359-362.

Subhash, Jani N., 1966. "The Age Factor in Stereopsis Screening," American Journal of Optometry and Archives of the American Academy of Optometry, 43:653-657, Oct.

Westheimer, Gerald, and Suzanne McKee. 1979. "What Prior Uniocular Processing is Necessary for Stereopsis?" Investigative Opthalmology and Visual Science, 18(6):614-620, June.

Williams, Harriet Grace. 1968. "The Effects of Systemic Variation of Speed and Direction of Object Flight and of Skill and Age Classification Upon Visuo-Perceptual Judgements of Moving Objects in Three Dimensional Space." Ph.D. dissertation, University of Wisconson.

APPENDIX A

SUMMARY OF RAW DATA

CONTROL GROUP

TABLE 4

SUMMARY OF RAW DATA CONTROL GROUP

		LAFAYETTE (cm)			TITMUS (° of arc)			RANDOM DOT (° of arc)		
SEX	AGE (Months)	PRE	POST	DIFF.	PRE	POST	DIFF.	PRE	POST	DIFF.
F	70	.600	.667	-.067	20	25	-5	20	20	0
F	67	.533	2.233	-1.700	20	20	0	20	20	0
M	87	3.067	1.967	+1.100	20	20	0	20	20	0
M	75	5.033	1.933	+3.100	30	50	-20	40	20	+20
F	54	3.433	3.000	+ .433	30	20	+10	40	20	+20
F	75	1.267	.967	+ .300	20	20	0	20	20	0
M	77	1.100	3.033	-1.933	25	25	0	20	20	0
M	74	1.067	.967	+ .100	25	70	-45	20	20	0
M	77	.800	1.900	-1.100	40	20	+20	20	20	0
MEAN	72.89	1.88	1.85		25.56	30.00		24.44	20.00	
S.D.	8.96	1.58	.86		6.82	17.85		8.82	0.00	
$S\bar{x}$	3.17	.56	.30		2.41	6.31		3.21	0.00	

+ Signifies improvement

APPENDIX B

SUMMARY OF RAW DATA

EXPERIMENTAL GROUP

TABLE 5

SUMMARY OF RAW DATA EXPERIMENTAL GROUP

Sex	AGE (Months)	Lafayette (cm)			Titmus ($^{\circ}$ of arc)			Random Dot ($^{\circ}$ of arc)		
		Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
F	70	1.967	2.167	- .200	20	30	-10	20	20	0
F	65	6.267	3.867	+2.400	20	20	0	20	20	0
F	66	3.600	.533	+3.067	20	20	0	20	20	0
M	60	2.167	1.000	+1.167	20	20	0	20	20	0
M	60	8.267	2.067	+6.200	70	70	0	100	70	+30
M	74	.600	.500	+ .100	25	40	-15	20	20	0
F	59	2.267	3.033	- .766	30	30	0	20	40	-20
M	71	2.100	1.533	+ .567	30	20	+10	20	20	0
M	76	3.167	.933	+2.234	25	30	-5	20	20	0
Mean	66.78	3.38	1.74		28.89	23.33		28.89	27.78	
S.D.	6.34	2.41	1.16		15.96	11.18		26.67	17.16	
$S\bar{x}$	2.24	.85	.41		5.64	3.95		9.42	6.06	

+ Signifies improvement