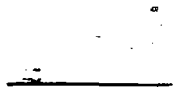


A COMPARATIVE STUDY OF THE EFFECT UPON
LEG STRENGTH AND HAND REACTION TIME
BY TWO WEIGHT TRAINING PROGRAMS

52



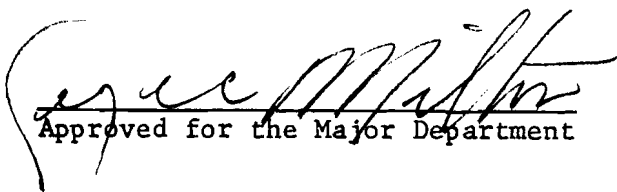
A Thesis
Presented to
the Department of Health, Physical Education
Recreation, and Athletics
Kansas State Teachers College of Emporia

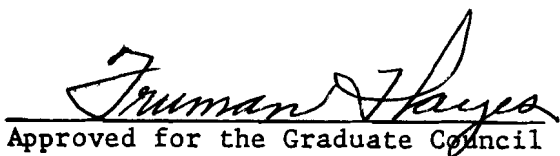


In Partial Fulfillment
of the Requirements for the Degree
Master of Science



by
Darrell H. Blachly
August, 1969


Approved for the Major Department


Approved for the Graduate Council

288267

8

TABLE OF CONTENTS

Chapter	Page
I. Introduction	1
State of Problem.	1
Definition of Terms	2
Leg Strength	2
Hand Reaction Speed.	2
Nelson Reaction Timer.	2
Exer-genic Exerciser	3
Isometric Exercise	3
Isotonic Exercise.	3
Control Group.	3
Athlete.	3
Vertical Jump Test	4
Limitations of the Study.	4
II. Review of Literature	5
Research Related to Isometric	5
Research Related to the Exer-genic Exerciser.	12
Summary of Previous Research.	18
Theoretical Implications of Previous Research	20
Relation of the Study to The Research	20
III. Procedure.	21
Nature of Physical Education Program Subjects	21
Subjects.	22
Equipment and Facilities.	23

Chapter	Page
III. Procedure	
Training Procedure.	23
Testing Procedure	27
Hand Reaction Time.	27
Vertical Jump Test.	28
Procedure for Recording Hand Reaction Time and Vertical Jump.	29
IV. Presentation of Data	30
Introduction.	30
The Significance of the Mean Gain for each group in Hand Reaction Time.	30
The Significance of the Difference between Initial and Final Hand Reaction Time Test Score for the three training groups.	30
Analysis of Variance.	31
Analysis of Variance of Hand Reaction Time Improvement for the Subjects in the three groups	31
The Significance of the Mean Gain for each group in Vertical Jump Test Performance.	32
The Significance of the Difference between Initial and Final Vertical Jump Test scores for the three training groups.	32
Orthogonal Comparisons.	33
V. Findings, Conclusions, Discussion and Recommendations.	35
Findings.	35

Chapter	Page
V. Findings, Conclusions, Discussion and Recommendations	
Conclusions	36
Discussion.	36
Recommendations	37
Bibliography.	38
Appendix A: The Exer-genic Exerciser	42
Appendix B: The Buddy System	44
Appendix C: Side View of Big 4 Exercise.	46
Appendix D: Front View of Big 4 Exercise	48

CHAPTER I

INTRODUCTION

The suggestion that athletes and/or physical education students be encouraged to participate in weight training, to improve certain areas or abilities was met, with a few exceptions, by a storm of protest or a wait-and-see attitude. Prior to the 1940's the attitude of many coaches and physical educators has taken a turn, and now many are using a weight-training program in their athletic program and physical education classes to accomplish a number of items.

Research in this area has been centered around isotonic and isometric weight training programs and, thus far, very little has been done with the new exer-genic exercisers. "The Exer-genic is used for both isometric exercise, or exercise without movement aimed at building muscle strength, and isotonic exercises, those with movement to increase agility and endurance."¹

I. STATEMENT OF THE PROBLEM

The purpose of this study was to investigate the comparative effects of two programs of weight training upon the development of hand reaction speed and leg strength on thirty junior high school boys.

¹James E. Bylin, "More Pro Athletes Keep in Shape Toiling With Tiny Exer-Genic," (Wall Street Journal, Sept. 1966)

More specifically, this study will attempt to answer the following questions: (1) Will an isometric exercise program lasting for five weeks bring about a significant gain in hand reaction speed and leg strength? (2) Will an exer-genic exerciser program lasting for five weeks bring about a significant gain in the development of hand reaction speed and leg strength? (3) Will there be a significant difference between the exer-genic group and the isometric group in the development of hand reaction time and leg strength?

II. DEFINITION OF TERMS

Leg Strength. A term that is used to define the amount of strength in the legs. Primarily, it is the ability of the body to develop power in relation to the weight of the individual by using the legs in jumping.²

Hand Reaction Speed. The measuring of the hand speed in one-thousandths of a second, from when the eye sees the object move until the hand begins the initial movement and reacts to catch the falling object.³

Nelson Reaction Timer. A device that is similar to a ruler in size; that is measured off in one-thousandths of a second. This device is accurate in measuring hand reaction speed.⁴

²H. Harrison Clarke, Application of Measurement, Prentice-Hall, Englewood, California, 1961.

³Ibid.

⁴Nelson Reaction Timer, (from a pamphlet published by Nelson Reaction Timer Company, 1966)

Exer-Genic Exerciser. A device that consists of ten feet of rope, its mid-portion twisted around a shaft inside a seven and three-fourths inch by one and three-fourths metal cylinder. The ends of the rope protrude from two openings in one end of the cylinder. The other end has a hook which can be attached to a wall or on a piece of wood ten inches wide, eighteen inches long and one-half inch thick. The device can be set at any amount of resistance up to four hundred pounds.⁵

Isometric Exercise. A program of "non-movement" exercise that develops strength with a minimum investment of time, while producing maximum strength development. It is a pushing, pulling, and lifting on a stationary bar.⁶

Isotonic Exercise. A program of developing the resistive and pulling muscles of the upper and lower body with the use of weights, barbells and dumbbells in a closely supervised program.⁷

Control Group. A term that will be used to explain a group that did not take part in either of the exercise groups, but did participate in the regular physical education class.⁸

Athlete. A person trained in exercise of games requiring strength, stamina, endurance, skill and speed.⁹

⁵Dean Miller, "Exer-Genic Exerciser," Fullerton, California, (A published paper, 1966) pp. 2-6.

⁶Webster's Intercollegiate Dictionary, (World Publishing Company, 1955)

⁷Ibid.

⁸Ibid.

⁹Ibid.

Vertical Jump Test. A test using a measured metal tape twelve feet long, marked off in quarter inches, taped on a masonry wall. The subjects used chalk on their finger tips, jumped up straight off both feet, touching the tape on the wall with the dominant hand. The jump was measured where the chalk dust was found.¹⁰

III. LIMITATIONS OF THE STUDY

- (1). The researcher was limited to approximately fifteen minutes a day at the beginning of the physical education class during school days.
- (2). The number of subjects was limited to thirty male students.
- (3). The time allowed was five days a week for five weeks in which the testing and exercise program was conducted.
- (4). There was no control over sleep and diet of the subjects.
- (5). There was no control over exercise and work at home or during the time before and after school hours.
- (6). There was no control over previous experience of weight training programs.

¹⁰Ibid.

CHAPTER II

REVIEW OF LITERATURE

In an attempt to better understand some of the factors involved in weight training with regards to speed, muscle development and reaction speed, this review of previous research will be categorized under the following headings: (1) weight training with isometrics; (2) weight training with the exer-genic exerciser.

I. RESEARCH RELATED TO ISOMETRICS

Pitman¹ in his study of the effects of a weight training program for junior high school boys used forty boys on a system of progressively heavier weights for a six month period.

Following the pre-test of the Junior Amateur Athletic Union Physical Fitness Test, Pitman placed the subjects in matched pairs. The experimental group met twice weekly and undertook a program of six different weight training exercises while the control group participated only in the regular class activities. The training period was followed by the Junior Amateur Athletic Union Physical Fitness Test. Pitman found that the experimental group increased in all areas tested as did the control group, with the exception of the mile run. The mean of the experimental group increased on the mile run more significantly than did the control group.

¹Joseph P. Pitman, "A Comparative Study of the Effects of a Weight Training Program of Junior High School Boys," (unpublished Master's of Arts Thesis, State University of Iowa, Iowa City, Iowa, 1959).

Wilken² in his study on the effects of weight training on speed and movement, concluded that participation in weight training for one semester had no slowing effect on the speed of arm movement. Wilken used two experimental groups and a control group. One experimental group did not have prior weight lifting or training experience. The second group had taken part in physical education classes of instructional swimming and golfing only. The third class had an average of two and one-third years of weight training.

A test and retest on arm speed movement of Wilken's selection was given to all three groups. It was found that after the weight training exercise all three groups showed a significant increase in speed. Wilkens drew this conclusion: That over one semester weight training showed no slowing effect on speed of arm movement as measured in the test. The retest showed a .75 correlation in maximum movement of arm speed in favor of the weight lifters over the control group.

The purpose of Endres³ study was to investigate the effect of a period of overload training on the dominant arm upon the speed of elbow flexion and extension. Endres used two groups of forty-four boys between the ages of fourteen and sixteen from the University of Wisconsin High School.

Using an exercise group and a control group, Endres used the study that follows. The flexion and extension movement of the elbow joint

²Bruce Wilken, "The Effects of Weight Training on Speed of Movement," Research Quarterly, October, 1952. pp. 361-69.

³John Paul Endres, "The Effects of a Period of Overload Training Upon the Speed of Elbow Flexion and Extension," Master of Science Thesis, University of Wisconsin, Madison, Wisconsin, 1953.

was done by using resistive weights varying from four to eight pounds. With the forearm resting on the thigh, with the back straight, a full flexion followed by a full extension of the elbow took place.

Endres found that by using weights he had increased at least fifty per cent for the exercise group, where as compared to a twenty-four per cent or less increase in the control group that used no weights. Endres found that the two groups showed an increase in speed and strength of the elbow flexors and that they were significant to the .01 level of confidence. Endres concluded that there is evidence that weight training does nothing detrimental to speed of elbow flexion and extension.

In Colgates'⁴ study his purpose was to find out if strengthening of the arm and shoulder muscles is accompanied by a decrease in the speed of movement time. In his study he used forty-nine college men divided into three training groups and a control group, with the training groups exercising with pulley weights. Strength and speed of arm and shoulder muscles scores were recorded before and after a six-week training program for each subject.

The following conclusions were reached: (1) a significant increase in the mean strength of the arm and shoulder muscles was accompanied by a significant increase in arm speed in the tested position, (2) the relationship of arm and shoulder strength to arm and shoulder speed is not always significant or positive.

⁴John A. Colgate, "Arm Strength Relative to Arm Speed," Research Quarterly, Volume 37, (March, 1966), pp. 14-22.

Brown and Riley⁵ used a class of forty freshmen basketball players on the Springfield College team to check the effect of weight training on the leg and the vertical jump. Two groups were used, one experimental and one control group, for a period of five weeks. They exercised three days a week using a hanging basketball.

After the initial and final tests of Sargents Jump Test were given, the mean scores were compared, and it was found that there was an increase of 2.9 inches and a t of 8.7, which is significant beyond the .01 level of confidence. A steady increase was shown throughout the study by both groups.

Callahan⁶ used forty-two male students from a physical education class at Arkansas State College in his study of an isometric program on the influence of the vertical jump. The students were divided by random sampling, into three groups: (1) isometric; (2) rebound tumbling; (3) and a control group.

A comparison of the scores after a test and re-test of the Vertical Jump Test showed that the scores of the isometric group increased by six per cent, the rebound tumbling increased by five per cent and the control group increased by three per cent. When the t test scores were applied to the isometric group, it was found to be significant to the .05 level of confidence when compared to the

⁵Robert J. Brown and Douglas R. Riley, "The Effect of Weight Training on Leg Strength and the Vertical Jump," Master of Science Thesis, Springfield College, Springfield, Massachusetts, 1957.

⁶Harold Franklin Callahan, "The Effects of Isometric Training and Rebound Tumbling on Performance In the Vertical Jump," Master of Science Thesis, Arkansas State College, Jonesboro, Arkansas, 1941.

control group. When the isometric group was compared to the rebound tumbling group, the increase was not significant.

Meisel⁷ used one hundred and sixty college male students in a voluntary weight training class that covered six weeks. The program used was one of the conventional type, isotonic and isometric combined into a series of progressively strenuous exercises.

An initial and final test of a back and leg dynamometer, and a comparison of the initial and final test showed progressive weight resistance exercises significantly increased the strength of the legs and back.

Lorback⁸ used sixty college males from Pennsylvania State University one half of the spring semester in a study concerning short static contraction as compared to customary weight training methods used in the development of muscle girth and strength. The subjects were divided by random sampling into two groups of thirty each.

After a test and re-test on a dynamometer, Lorback found that both groups increased significantly in strength development and that the static contraction method is at least as effective for strength development as the traditional method of repeated exercise.

⁷Stephen G. Meisel, "The Effect of a Weight Training Program on the Speed of Running," (Unpublished Master Thesis, Pennsylvania State University, University Park, Pennsylvania, 1937).

⁸Melvin M. Lorback, "A Study Comparing the Effectiveness of Short Periods of Static Contraction To Standard Weight Training Procedures," (Unpublished Master Thesis, Pennsylvania State University, University Park, Pennsylvania, 1955).

Ness and Sharos⁹ used thirty varsity basketball players from Springfield College dividing the subjects into two groups; the first group had been weight trained; the second group was non-weight trained and without formal conditioning. The first group worked for four weeks doing two exercises: (1) knee bends with a barbell on shoulders; (2) toe raisers with a barbell on shoulders. Each exercise was repeated three times with one minute rest between each repetition, and each exercise consisted of five to ten repetitions. The second group did no weight training, but did practice basketball. The Sargent Jump Test was used as the method of collecting data.

The results of Ness and Sharos' study showed that there was a significant increase in leg strength from this program and that four weeks was ample time to increase leg strength.

Maxim¹⁰ for a twelve week period used a physical education class at Springfield College doing isometric exercises, using single and repetitive routines, based upon the increase of skeletal muscles.

Maxim assumed from the study that the amount of strength gained in any of the groups was dependent upon the type of exercise, not the method in which it was applied. Maxim also concluded that all subjects in the single and repetitive exercise groups showed significant increase in muscular strength and development.

⁹Phillip E. Ness and Charles L. Sharos, "The Effect of Weight Training on Leg Strength and Vertical Jump," Master of Science Thesis, Springfield College, Springfield, Massachusetts, 1956.

¹⁰Asa M. Maxim, "The Effects of Isometric and Isotonic Exercises on the Strength of Skeletal Muscles," Thesis, Doctor of Physical Education, Springfield College, Springfield, Massachusetts, 1959.

Berger and Hendersons,¹¹ research lasting for a period of eight weeks, using sixty-six male college students, a Standard Leg Dynamometer for a test and re-test situation, set out to determine whether static or dynamic leg strength was more related to leg power. This was done by using isotonic and isometric exercises and by increasing the load or the resistance while the muscles worked against a resistive force. It was concluded that neither static leg strength nor dynamic leg strength was more related to leg power than the other.

Zorbas and Karpovich¹² used six hundred men from the ages of eighteen to thirty to test for rotary arm speed. These men were divided into two groups of three hundred each. The control group consisted of men who had never indulged in weight lifting. The second group, or weight lifters, was composed of men who had participated in weight lifting for a minimum of six months. The test ran for a period of six months in which the weight lifters continued to lift weights and the control group went ahead with regular class activities with a maximum of thirty in the class.

In the analysis of the data it was found that the weight lifters were faster in the speed of rotary arm motion than the non-lifter. A difference of .174 seconds which is significant to the .01 level of confidence.

¹¹Richard A. Berger and Joe M. Henderson, "Relationship of Power to Static and Dynamic Strength," Research Quarterly, March, 1966.

¹²William S. Zorbas and Peter V. Karpovich, "The Effect of Weight Lifting Upon Speed of Muscular Contraction," Research Quarterly, April, 1951.

II. RESEARCH RELATED TO THE EXER-GENIC EXERCISER

A small metal cylinder through which a nylon line is pulled with convenient wooden handles attached to the end of the line, and the force required to pull the line through the cylinder can be varied from zero to four-hundred pounds by rotating the outer sleeve of the cylinder.¹³

Dom Gentile lists the advantages of the Exer-genic over other modes of exercising and conditioning.

1. It is economical; a few dollars will suffice for a complete training and physical-fitness program. The exer-genic can be set up anywhere.

2. The exer-genic actually pays for itself many times over by reducing serious injuries and minimizing the severity of those which do occur.

3. Anyone over the age of twelve can benefit from this completely safe and easy-to-use exercise. It's the ideal supplement for physical education classes.

4. It offers the fastest and best route to prime physical conditioning. Imagine getting a complete physical work-out in only six minutes a day!

5. Athletes cannot cheat because they must work against a set resistance through full range of motion: they must exert themselves to do this.

¹³Developing Physical Regime for Astronauts, Lockheed MSC Star, November 24, 1965.

Some other opinions on the exer-genic come from the following coaches and physical education teachers. Coach Jerry Eckman, highly successful basketball mentor at Southwest High of Green Bay, is using the exer-genic to improve jumping ability, strengthen the arms, and help maintain strong physical condition. Jim Nolan, director of physical education at West De Pere, Wisconsin High School, reports that the exer-genic has eliminated inactivity in large classes. Students not participating in the activity of the day use the exer-genic. This device doesn't require strict supervision and can be used anywhere in the gym. Students generally excused from physical education classes because of physical ailments can now enjoy the benefits of physical fitness.¹⁴

The first published study to actually test the theory of the exer-genic was conducted using a submarine crew. A submarine crew was chosen as a valid test group because all members (subjects) are eating the same food and are resting near the same amount and more important, most subjects have the same recreational facilities.

Each was tested before he went to sea by the Heart-O-Meter and the Harvard Step Test of Endurance. While at sea, the subjects worked for six minutes each day on the exer-genic. The resting pulse of each subject was taken three times each day. When the crew returned after sixty-nine days at sea, the Heart-O-Meter and the Harvard Step Test of Endurance was given to each. In all, six separate full crews were

¹⁴"A New All-Around Exercise," Dom Gentile, Assistant Trainer, Green Bay Packers, January, 1966. Scholastic Coach.

tested with all doing six minutes a day of exercise while at sea for an average of sixty-eight days per crews.¹⁵

RESULTS OF THE EXER-GENIC EXERCISES ON THE SIX CREWS ARE :

Chest: Increase of 3.06 inches
 Bicep: Increase of 2.56 inches
 Forearm: Increase of 1.51 inches
 Thigh: Increase of 2.26 inches
 Weight: Loss of 5 pounds, 7 ounces
 Waist: Loss of 1.73 inches
 Increase in strength of the heart beat on the Heart-O-Meter from 51 centimeters to 79 centimeters. Increase of 19% in Harvard Step Test of Endurance. Average pulse dropped four beats per minute. Number who could touch finger tips to ground increased from 39% to 71%

In another study by Miller¹⁶ students were used in resistive exercise classes at San Jose State and these students were divided into two groups, by number after two weeks of testing on strength development and body measurement in the beginning of a new semester. One group worked forty minutes per class period on weight training in a well-equipped gym. The second group worked only six minutes per class period with the exer-genic and then went to the showers. At the end of the semester, both groups were re-tested over strength development and body measurement.

Both groups were similar on development of strength; both groups were very close on all body measurements with the exception of the biceps, where the exer-genic groups increased an average of over .60 inches more than the weight training groups, and in the waist line where the exer-genic group lost an average of 1.37 inches more than the

¹⁵Dean Miller, "Exer-genic Exerciser," Fullerton, California, (A published paper, 1966) pp. 2-6.

¹⁶Ibid. p. 4.

weight training group. The exer-genic group also had a nineteen per cent increase in endurance and a sixty-three per cent better increase in body flexibility.

In another experiment two thousand exer-genics were given to residents of a city. The residents of the city were carefully trained in the use of the machine and were asked to carry on a home program based on a six minute per day work out. All body measurements were taken and each person was tested for physical endurance, strength and body flexibility. Doing only three sit-ups a day with a ten second isometric contraction before each sit-up, and average of from one to seven inches were lost by one thousand six hundred and forty-one of the people involved.¹⁷

From some of the residents results were obtained using muscle isolation. One test involved twelve women from ages fifty-four to sixty-nine, and these women did the tricep pull. The women were able to reduce the upper arm and average of 1.91" in thirty days doing three repetitions tricep pulls per day.¹⁸

In order to study flexibility of young boys, three thousand boys of high school age, none of whom were in competitive sports, were asked to do certain exercises. First, each was to bend down and touch the floor with his fingers. When this experiment was started sixty-six per cent could do this, and at the end of a nine week training program on the exer-genic, just six minutes a day, ninety-six per cent could touch the floor.¹⁹

Each boy was then asked to touch his palms on the floor; the percentage increased from forty-five per cent to eighty-eight per cent after using the exer-genic. Each boy was then asked to again bend down and touch his head to the ground by spreading his legs out. In this the percentage increased from three per cent to fifty-one per cent after the exer-genic was used for the same nine week period of

¹⁷Ibid., p. 4.

¹⁸Ibid., p. 5.

¹⁹Ibid., pp. 5-6.

only six minutes a day.

McKinney and Logan²⁰ used members and potential members of the varsity baseball team for a study concerning the effect of resistance through a throwing range-of-motion on the velocity of a baseball. The purpose of McKinney and Logan in this experiment was to see how much speed a player could gain in throwing the ball by performing an exercise which involved pulling the baseball against a resistant pressure. McKinney emphasizes:

The feeling in athletic exercise these days is working on specific muscles for a particular sport. Lifting weights will build up the arms, but this exercise develops the particular muscles needed to throw a baseball.²¹

Three groups of boys were divided into as near as equal ability groups as possible. Group one pulled the ball through the exer-genic thirty times a day, five days a week, for six weeks. Group two threw a baseball thirty times a day in a regular throwing motion, not using the exer-genic. Group three did nothing except take an initial and final test.

After the final test, group three showed no change in speed. Group two had increased its speed from 75.895 mph to 78.842 mph. Group one upped its speed from 75.895 mph to 84.001 mph. Group one increased significantly over the other two groups.²²

Phil Bengston, line coach of the Green Bay Packers, is using a new exercise which combines isometrics with isotonics. First, the

²⁰Exer-genic Gives Fast Ball Boost, Sunday News and Leader, January 9, 1966, Springfield, Missouri.

²¹Ibid.

²²Ibid.

other end by another player, or held by the exerciser himself so it will not move. This is the isometric. Then the athlete completes the exercise by pulling the rope through the calibrated resistance. This is the isotonic.

Line Coach Phil Bengston of the Green Bay Packers explains:

A player can't really get himself in shape because he exercises only until he gets tired, then quits. He needs someone to force him to keep going. The real benefit is obtained when you work after you're tired.²³

There are several advantages to Bengston's method over the old method of callisthenics: (1) Exercise time is cut down considerably, (2) Not as much soreness and stiffness results, (3) The exercises loosen the athletes' muscles and eliminates soreness.

Dr. James Brusky, one of the Green Bay Packer team physicians, explained the advantages in this manner:

When a muscle is fatigued it builds up lactic acid, especially after repetition of an exercise over a long period of time. These exercises take a short time and do not cause such a build-up of the acid, which causes stiffness and cramps.²⁴

The Green Bay Packers start exercises with what is called "the big four." This is an over-all conditioner, working most of the muscles in the body. The "big four exercise" is accomplished in four movements.²⁵ Mangelsdorf states this opinion about the exer-genic:

The cardiovascular, respiratory, and musculoskeletal systems are expected to deteriorate unless specific

²³A New Push-Pull for the Packers, The Milwaukee Journal, by Chuck Johnson, August 8, 1965

²⁴Ibid.

²⁵Ibid.

measures are taken to prevent the body adapting to an environment that requires a minimum of physical effort. A carefully selected exercise program should alleviate the effects of weightlessness, confinement, and relative inactivity.²⁶

The advantages of the exer-genics are that it is light-weight, it can be operated effectively under zero-gravity conditions, and it can be used for both isometric and isotonic exercise, which are necessary to the conditioning of muscles, bones, and the cardiovascular systems.

Crewmen of spacecraft on missions lasting weeks or months could keep in good physical shape by use of a simple exercise device weighing only 1½ pounds.

III SUMMARY OF PREVIOUS RESEARCH

The review of literature has indicated numerous factors that might be taken into consideration in determining the effects of weight training with isometrics and with the exer-genic. The review can be summarized in the following points.

1. Some improvement was found in all weight training programs. (1)
2. Weight training has no slowing or detrimental effect on speed or movement of the body. (2)
3. Hand and arm speed increased with strength in shoulder muscles to a .75 correlation on a test - retest. (3)
4. Time is of some factor; a period of six weeks or more is usually needed. (4)

²⁶Ibid.

5. Short static contractions are better than the customary weight training method. (11)
6. Previous training is not needed to show an improvement. (11)
7. Type of exercise is more important than the method with which it is applied. (11)
8. Leg power cannot be related to either static or dynamic leg strength. (11)
9. Weight lifters improved in rotary arm speed over the non-lifter to a difference of 174 seconds which is significant to the .01 level of confidence. (12)
10. Jumping ability can be increased and a steady increase was shown throughout. (5)
11. The exer-genic improves the body in many more ways: respiration, heart, weight reduction, strength, and flexibility. (13)
12. A shorter time is needed for the exer-genic than regular weight training. (14)
13. The exer-genic can be used by any person; young or old, male or female. (16)
14. The exer-genic can develop certain areas quickly. (16)
15. An increase in speed of arm movement was shown with the increase of speed in throwing a baseball from 75.895 mph to 84.001 mph. (18)
16. The exer-genic reduces athletic injuries and minimizes the ones that do occur. (21)
17. The exer-genic benefits the physically handicapped because of its simplicity. (21)

IV. THEORETICAL IMPLICATIONS OF PREVIOUS RESEARCH

The review of literature would seem to indicate there is a positive influence upon arm and hand speed and leg strength with the use of a weight training program and with the exer-genic exerciser. There is, however, some doubt as to the proven effectiveness of the exer-genic exerciser. Much of this doubt is concerned primarily with the newness of the exer-genic.

V. RELATION OF THE STUDY TO THE RESEARCH

The investigator hoped to determine whether or not the difference derived from the exer-genic exercise as to the isometric exercise would have a significant influence upon the hand reaction time and leg strength.

CHAPTER III

PROCEDURE

In an effort to compare two methods of weight training upon leg strength and hand reaction time on thirty junior high school males, the male subjects were broken down into three groups; exer-genic, isometric and control. The Nelson Reaction Timer and a Vertical Jump Test was used to measure the results taken on these boys. The researcher introduced a weight training program lasting five days a week for five weeks.

I. NATURE OF THE PHYSICAL EDUCATION PROGRAM

The students were enrolled in the Hamilton, Kansas Junior High School Physical Education Class during the fall semester of 1966. The weight training program started on March 6, 1967, because of time between basketball and track seasons, and ended on April 7, 1967.

The morning class consisted of twenty-one seventh and eighth grade male students from the ages of twelve to fifteen years. This group participated in physical education class for 55 minutes each period five days a week for five weeks. All members of the group participated in the regular physical education class activities, that were set up by the instructor and superintendent of the school.

The afternoon class consisted of thirty-six male and female students. In this class, nine of the male students were chosen because

of the correct age for this study, which was twelve to fifteen years of age. The age of twelve to fifteen was selected by the investigator for this study because of its availability at the school. The afternoon physical education class participated in the regular physical education class for 55 minutes five days a week for five weeks. The activities were the same as the morning physical education class, which was selected by the instructor and superintendent of the school.

II. SUBJECTS

The ages of the classes ranged from twelve to fifteen years of age. Within the morning class of twenty-one members twelve of the subjects were members of the junior high school varsity basketball and track squads. The remainder of the class took part in the regular physical education class activities and had no scheduled outside competition to the knowledge of the investigator. In the afternoon class of nine subjects, five of these were out for the high school varsity basketball and track squads, while the remaining four took part in regular physical education class activities and had no scheduled outside competition to the knowledge of the investigator.

The subjects were assigned to the three groups by a random sampling using every third name in the class role book. This was done in order to form, as nearly as possible, three equally matched groups. The assigning to the three groups by random sampling was chosen because of the unstableness in the boys maturation and development during this age group.

III. EQUIPMENT AND FACILITIES

The study was conducted in the Hamilton, Kansas High School gymnasium of which the major area is a basketball court sixty-five feet long and forty feet wide. Two iron pipes, one and one-half inches in diameter, were placed in front of the seats and running parallel to the basketball court on one side of the gymnasium to provide a guard rail between spectator seating and the playing area. These bars were placed at a distance of two feet and three feet from the floor of the basketball court, and the two pipes were one foot apart. The walls of the gymnasium are made of masonry and wood providing ample space for the exercises. On the other side of the area, across from the seating section is a stage area. This area was used in the testing as an observation area for the investigator to observe the subjects as each did his exercises. The devices that were used in this study consisted of: (1) three exer-genic exercisers; (see appendix) (2) two pipes, one and one-half inches in diameter that were used in doing the isometric exercises used in the study; (3) a Nelson Reaction Timer was used to time the hand reaction speed of the subjects; (4) a ten foot measuring tape marked in quarter inches. This tape was affixed to the wall of the gymnasium serving as the measure of vertical jumping ability.

IV. TRAINING PROCEDURES

After the subjects were assigned by random sampling to respective groups and prior to the beginning of the initial test, the subjects were given one class period on instruction about the isometric and

exer-genic exercisers to be employed as exercisers.

To facilitate the setting of the machine and to give more time to the subjects to devote to the exercise the exer-genic group was grouped in such a manner that allowed two subjects to work together. This was done as nearly as possible by body weight and height. By pairing off, one subject could control the resistance that would be needed for the partner and a resetting would not be necessary. The exer-genic exercisers were set at a resistance of twenty pounds for the entire five week program. This resistance was used because it is light enough resistance so that it could be controlled and made the resistance that was needed by the subjects offering resistance.

The program of exercise used by the exer-genic group was the "Big Four".¹ The Big Four is the most common combination of isotonic and isometric exercise. "This is a resistive exercise program, based on the overload principle. First we tire the muscle, then we move it. We use isometric to tire and strengthen it, and then we use isotonic to build the flexibility and endurance."²

The Big Four exercise is started with the subject in a knees-flexed position on the balls of his feet. The bar is held in the hands, with the fingers wrapped around the bar in a palms-down position. The bar is held between the subject's flexed knees, with the arms and back straight. The head and eyes of the subject were looking up (See appendix). In this position the subject began a ten second isometric

¹Dean Miller, "Exer-Genic Exerciser," Fullerton, California, (A published paper, 1966) pp. 12-14.

²Ibid.

pull. The next move is to straighten the legs, which is followed by the pulling of the bar and rope to the subject's waist. At this position another ten second pull is exerted. The bar is then pulled up to the shoulder level and the hands are rolled under the bar in a palms-up position, and in a military press movement, the exercise is continued upward until the subject can reach no further. Three repetitions were done by each subject in the exer-genic group in each physical education class period.

In the isometric training group the investigator selected two exercises: (1) the front curl; (2) the low back pull. These were selected because the investigator felt that with the facilities at hand these would accomplish the development that was needed for the investigation. The front curl was accomplished by facing the high bar, which was three feet from the floor, with the arms flexed at the elbows at a ninety degree angle. To accomplish this for the shorter subject, empty pop cases were used to adjust for the height difference. The hands extended out frontwards with the palms up, and legs and back were straight. A full six second contraction with a thirty second rest between each repetition was completed by each subject each day. Three repetitions of the front curl were done by each member of this group, during the first fifteen minutes of each day in the physical education class period. The subjects were told to increase their count one second more each week, until a ten second contraction was reached.

The low back pull was done with the subject facing the lower bar, which was two feet from the floor, with the knees and legs in a flexed

position with the lower back in a straight position, and standing on the balls of his feet, head and eyes looking upward, arms hanging downward, and with the fingers wrapped around the bar in a palms-up position. The subjects attempted to straighten his legs to a standing position. The subjects did a six second full contraction and added one second each week until a ten second contraction was achieved. A thirty second rest period was taken between each contraction. Three repetitions were done by each member of this group during the first fifteen minutes of each day in the physical education class period for five weeks.

Neither experimental group had a timing device or clock. Because of the differing times the subjects reached the exercise floor from the dressing room, clocks were not feasible. In place of a clock or timing device each subject or pair of subjects were told to count aloud in a slow steady count. The counting was done by the subject in the following manner by both groups: one thousand one, one thousand two, one thousand three, etc. This counting was checked very closely by the investigator to see that a uniform count was being used.

The stage area was used as a checking area to check on the counting of the contractions and the effort put into the exercise. The exer-genics were placed on the basketball court and the isometric group stood facing the pipes around the gymnasium that were used for the isometric exercises.

Upon the entrance of the subjects onto the basketball floor from the locker room, the exercise routine began immediately. After going through the exercise the subjects were to report to the investigator

aid so a record of attendance and exercising could be kept. When all subjects were through with the exercise routine the regular physical education began. During the time that the two groups were exercising, the control group would be preparing the equipment necessary for the day's class activities.

V. TESTING PROCEDURE

This study consisted of fifteen minutes every day of the school week for five weeks. The physical education class periods used were from March 6 to April 14, 1967. Time was taken at the beginning of each class period for the two groups to complete the exercise routine. The following tests were conducted in this study: (1) initial and final test of the hand reaction time; (2) initial and final test of the vertical jump test. All tests were given on Friday. The investigator had one aid in this study, a senior from Hamilton High School to help in recording of information reported by the investigator. The investigator did all the measurements and recorded the measurements on the individual's statistic sheets.

HAND REACTION TIME

For the initial test of the Hand Reaction Time, the subjects were informed of the operation of the Nelson Reaction Timer and one subject was brought in front of the class and demonstrated the proper arm and hand position. Before the testing began the subjects formed a column, along and in front of the stage area. The investigator positioned himself in a chair on the floor facing the column of subjects.

The subjects placed his dominant arm and hand on the stage. The arm was flexed at the elbow, with the forearm resting on the stage, so that the wrist, hand or fingers were not touching the stage in any way. A catch is defined as follows: the subject hand is placed in a cupped position, the Nelson Reaction Timer was placed in a position so that it was between the thumb and the index finger of the subject's cupped, dominant hand. The timer was held by the investigator so that it is not in contact with the subject's relaxed thumb and index finger. The investigator would drop the timer at any interval, so no system of continuity could be established. The subjects were instructed not to bend his hand, wrist or arm in an attempt to catch the timer. If this was done the catch was not recorded and another try was given.

After the position was established and comfortable to the subject, he was given five practice catches to become familiar with the testing device. When the subject was ready, he was given five catches. The top calibrated marking on the timer that showed over the thumb and index finger of the subject's hand was recorded. Each catch was called out by the researcher and recorded by the investigator's aid and later recorded by the investigator on the subject's individual statistic sheet.

The final test on the Hand Reaction Time was administered in the same manner as the first Hand Reaction Time Test.

VERTICAL JUMP TEST

A steel tape ten feet long, marked off in quarter inches, was taped to a masonry wall two feet from the stage area. The investigator took a position on the stage about two feet from the tape so a more accurate measurement could be taken.

The subjects were instructed to stand with the dominant hand nearest to the wall. There would not be preliminary steps or running steps allowed and each subject was required to jump upward and touch the tape reaching as high as possible. If any foot movement was observed by the investigator the jump was omitted. Chalk was placed on the finger tips of each subject, after three practice jumps and prior to each official jump. A total of three official jumps was taken from each subject. The height was called out by the investigator and recorded by the investigator's aid and later recorded on the individual student's statistic sheet by the investigator.

PROCEDURE FOR RECORDING HAND REACTION TIME AND VERTICAL JUMP

After the initial and final tests of the Nelson Reaction Timer were given, the scores were examined by the investigator. The fastest and the slowest of the five catches were thrown out and the remaining three catches were averaged to the nearest one thousandth of a second.

For the final results of the Vertical Jump Test, the final three official jumps were averaged to the nearest quarter of an inch.

After all tests were completed and the averages obtained, the initial test scores of the Nelson Reaction Timer and the Vertical Jump Test were compared to the final test scores to obtain the difference, if any, that existed between the initial and final test.

CHAPTER IV

PRESENTATION OF DATA

I. Introduction

There were two statistical analyses computed in studying the effects of exer-genic and isometric training programs on Hand Reaction and Vertical Jump Performance. These statistical methods were: (1) the significance of the difference between correlated means; and (2) analysis of variance with orthogonal comparison

The data used in this study was gains made between the initial and final scores on Nelson Hand Reaction Test and Vertical Jump Test.

II. The Significance of the Mean Gain for Each Group in Hand Reaction Time

To establish the significance of the mean gains in Hand Reaction Time performance t tests were computed comparing the initial and final Hand Reaction Time test scores for each of the three groups. This data is presented in Table I for all groups. In order to reach significance a t of 2.26 was needed for the .05 level of probability, and a t of 3.25 was required to be significant at the .01 level.

TABLE I

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN INITIAL
AND FINAL HAND REACTION TIME TEST SCORES FOR THE THREE TRAINING GROUPS

Group	N	Initial Mean	Final Mean	Mean Diff.	S.E. Diff.	t	P
Exer-genic	10	.224	.211	.013	.38	.034	.05
Isometric	10	.205	.197	.008	.62	.012	.05
Control	10	.216	.208	.008	.47	.017	.05

t needed: 2.26 for .05 level of probability
3.25 for .01

From Table I it can be seen that a significant t - ratio was not found for any of the three groups. Group 1 or the exer-genic group, had a mean difference between the initial and final Hand Reaction Time test of .013 which resulted in a t of .034; Group 2 or the Isometric Group had a mean difference between the initial and final Hand Reaction Test of .008 which resulted in a t of .012; Group 3 or the Control Group had a mean difference between the initial and final Hand Reaction Time test of .008 which resulted in a t of .017.

III. ANALYSIS OF VARIANCE

Analysis of variance was used to determine if there were significant differences in the gains among the 3 groups in both Hand Reaction Time and Vertical Jump performance. Analysis of variance was used rather than co-variance because the coefficient of correlation for both initial tests for the experimental groups and the gains made in the two measurements were extremely low, .04 and -.04 for Group 1 and .27 and -.42 for Group 2. When there is a relatively low correlation between initial status and gain, this indicates that there is not a large proportion of the variability fo the final scores that can be attributed to the variability of the initial scores. Therefore, the use of co-variances was not warranted.

Analyses were made on the gains made between the initial and final tests of both Hand Reaction Time tests and the Vertical Jump tests. The results are shown in Tables III and IV for the three groups.

TABLE III
ANALYSIS OF VARIANCE OF HAND REACTION TIME
IMPROVEMENT FOR THE SUBJECTS IN THE THREE GROUPS

Source of Variance	Sum or square	d f	Mean Square	F	P
Among	120	2	60	.237	.05
Within	6866	27	254		
Total	6987	29			

F needed at .05 level, 3.33
.01 level, 5.42

IV. THE SIGNIFICANCE OF THE MEAN GAIN FOR EACH GROUP IN VERTICAL JUMP TEST PERFORMANCE

To establish the significance of the mean gains in the Vertical Jump Test performance, t test was computed comparing the initial and final Vertical Jump Test scores for each of the three groups. This data is presented in Table II for all groups. In order to reach significance, a t of 2.26 was needed for the .05 level of probability, and a f of 3.25 was required to be significant at the .01 level.

From Table II it can be seen that a significant t - ratio was not found for any of the 3 groups. Group 1 or the exergenic group, has a mean difference between the initial and final Vertical Jump Test of .90 which resulted in a t of 3.46; Group 2 or the isometric group had a mean difference between the initial and final Vertical Jump Test of .30 which resulted in a t of .802; in Group 3 or the control group there was a mean difference between the initial and the final Vertical Jump Test of -.60 which resulted in a t of 1.05.

TABLE II

THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN INITIAL AND FINAL VERTICAL JUMP TEST SCORES FOR THE THREE TRAINING GROUPS

Group	N	Initial Mean	Final Mean	Mean Diff.	S.E. Diff.	t	P
Exer-genic	10	97.20	98.10	.90	.26	3.46	.01
Isometric	10	99.20	99.50	.30	.374	.802	.01
Control	10	99.60	99.00	-.60	.565	1.05	.01

t needed: 2.26 for .05 level of probability
3.25 for .01

The F - ratio of 3.55 for the Vertical Jump test was the only significant result of the computation of the analysis of variance.

ORTHOGONAL COMPARISONS

As a result of the significant F - ratio obtained in the Vertical Jump test, orthogonal comparisons were computed to identify the group or groups to which the differences could be attributed on the Vertical Jump Test.

TABLE IV

ANALYSIS OF VARIANCE OF VERTICAL JUMP GAIN PERFORMANCE FOR SUBJECTS IN THE THREE GROUPS

Sources of Variance	Sum of Square	d f	Mean Square	F	P
Among	11.4	2	5.7	3.55	.05
Within	43.40	27	1.60		
Total	54.80	29			

F needed at .05 level, 3.33
.01 level, 5.42

There are two comparisons permissible among three groups (N-1), although all of the allotted comparisons need not be computed. Table V shows the orthogonal comparisons made in this analysis.

TABLE V

ORTHOGONAL COMPARISONS

	Group 1	Group 2	Group 3
Mean Differences	-.90	-.30	-.60
Comparison 1	+1	0	- 1
Comparison 2	-1	+1	0

In the first comparison group 1, the exergenic training group, was

compared to group 3, the control group, because the largest differences in mean differences was evidenced between these two groups. This comparison yielded a sum of square of 8.52. When the F test was applied a significant F of 5.32 resulted, which indicated that there was a difference between the two groups, in terms of Vertical Jump Performance. It could therefore, be deduced from examining the mean scores that the Group 1, the group exercising with the exergenic, made a significant greater improvement than the subject without any form of supplementary exercise program.

For the second comparison Group 1, the exergenic group, was compared to Group 2, the isometric group. The sum of the square was found to be 1.62 which when tested for significance, yielded a non-significant F of 1.02. This non-significance illustrates that there was a difference on the Vertical Jump Test between the two groups after the two forms of supplementary exercise.

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS, DISCUSSION AND RECOMMENDATIONS

The purpose of this study was to investigate the effects of two methods of weight training, exer-genic and isometric, upon Hand Reaction Speed and Vertical Jump Performance of selected subjects.

For a five week period, two groups of Junior High boys participated in a program of exer-genic exercise and isometric exercise. The program consisted of an exercise period during the first fifteen minutes of every class period in which the supervisor would oversee all of the weight training program.

In an effort to find any significant improvement in the groups the following tests were conducted: (1) initial test and final test of the Nelson Hand Reaction Timer; (2) initial test and final test of the Vertical Jump Test.

I. FINDINGS

The limitation of the findings of this study are as follows:

1. With the aid of the exer-genic method of weight training no significant gain in Hand Reaction Speed can be found. A t score of .034 for the exer-genic as compared to a t score .012 for the isometric group.

2. A significant improvement of a t score of 3.46 for the exer-genic group to a t score of .802 for the isometric group was not noted in the Vertical Jump Performance Test.

3. When a comparison of the control group to the exer-genic group was made it was found that the exer-genic group test t scores were better

in both the Hand Reaction Speed and the Vertical Jump than the control group.

4. When a comparison of control group to the isometric group was made the t test scores showed a difference of .005 in favor of the control group over the isometric group, and a difference of .248 in favor of the control group over the isometric group.

II. CONCLUSIONS

Within the limitations of this study the following conclusions were made:

1. Hand Reaction Time and Vertical Jump Performance of Junior High boys may be improved, but not to a significant degree, by engaging in a program of isometrics and exer-genic exercise.

2. The control group showed more improvement than the isometric group, which could show a trend to slow down the hand reaction time.

3. The greatest amount of all three groups was found in comparison of the initial test and final test of the exer-genic group in the Vertical Jump Test.

4. The least amount of improvement was found in the initial test and final test of the Hand Reaction Speed, the greatest improvement was found in the Exer-genic group.

III. DISCUSSION

The results of this study showed improvement in favor of the exer-genic group, even though this improvement was not statistically significant. The small number of subjects used in this study, the shortness of time allotted for the investigation had a definite influence upon the significance of improvement that was shown between the three groups.

IV. RECOMMENDATIONS FOR FURTHER STUDY

1. Different age groups would be more desirable. Possibly from sixteen years of age up to senior college aged males.
2. Longer time period is needed, six months or possibly a year would be a better length of time.
3. Test over different measurements, such as leg speed, arm strength, flexation of elbows.
4. Give exer-genic program, then test different groups. For example: (1) muscle group; (2) weight group; (3) height group, or; (4) age groups, all the same ages in one group.
5. Compare exer-genic to different weight training programs, such as an isometric group.

BIBLIOGRAPHY

BOOKS

Harrison, Clarke H., Application of Measurement. Prentice-Hall, Englewood, California, 1961.

Webster's Intercollegiate Dictionary. (World Publishing Company) 1955.

PUBLISHED PAMPHLETS

Exer-Genic Gives Football Boost, Sunday News and Leader, Springfield Missouri, (January 9, 1966)

Johnson, Chuck. "A New Push-Pull for the Packers," The Milwaukee Journal (August 8, 1965)

Lockheed MSC Star, Developing Physical Regime for Astronauts, (November 24, 1965)

Miller, Dean. "Exer-Genic Exerciser," Fullerton, California, (A published Paper, 1966) 2-6.

Nelson Reaction Timer. (from a pamphlet published by Nelson Reaction Timer Company, 1966)

PERIODICALS

Berger, Richard A., and Henderson, Joe M. "Relationship of Power to Static and Dynamic Strength," Research Quarterly, March, 1966.

Bylin, James E. "More Pro Athletes Keep in Shape Toiling With Tiny Exer-Genic," Wall Street Journal, September, 1966.

Colgate, John H., "Arm Strength Relative to Arm Speed," Research Quarterly, Vol. 37, (March, 1966), 14-22.

Gentile, Don, "A New All-Around Exercise," Scholastic Coach, January, 1966.

Wilkins, Bruce, "The Effect of Weight Training on Speed of Movement," Research Quarterly, October, 1952. 361-69.

Zorbas, William S., and Karpovich, Peter V. "The Effect of Weight Lifting Upon Speed of Muscular Contraction," Research Quarterly, April, 1951.

UNPUBLISHED MATERIAL

- Brown, Robert J., and Riley, Douglas R. "The Effect of Weight Training on Leg Strength and Vertical Jump," Master of Science Thesis, Springfield College, Springfield, Massachusetts, 1957.
- Callahan, Harold Franklin, "The Effects of Isometric Training and Rebound Tumbling on Performance In The Vertical Jump," Master of Science Thesis, Arkansas State College, Jonesboro, Arkansas, 1941.
- Lorback, Melvin M. "A Study Comparing the Effectiveness of Short Periods of Static Contraction to Standard Weight Training Procedures," (unpublished Master Teesis, Pennsylvania State University, University Park, Pennsylvania, 1955).
- Maxim, Asa M. "The Effects of Isometric and Isotonic Exercises on the Strength of Skeletal Muscles," Doctor of Physical Education Thesis, Springfield College, Springfield, Massachusetts, 1959.
- Meisel, Stephen G. "The Effect of a Weight Training Program on the Speed of Running," (unpublished Master Thesis, Pennsylvania State University Park, Pennsylvania, 1937).
- Ness, Philip E., and Sharos, Charles L. "The Effect of Weight Training on Leg Strength and Vertical Jump," Master of Science Thesis, Springfield College, Springfield, Massachusetts, 1956.
- Pitman, Joseph P. "A Comparative Study of the Effects of a Weight Training Program of Junior High School Boys," (unpublished Master of Art Thesis, State University of Iowa, Iowa City, Iowa, 1959).

APPENDIXES

APPENDIX A

Appendix A



The Exer-genic Exerciser

APPENDIX B

Appendix B



The Buddy System that
was used for this survey

Appendix C

Appendix C

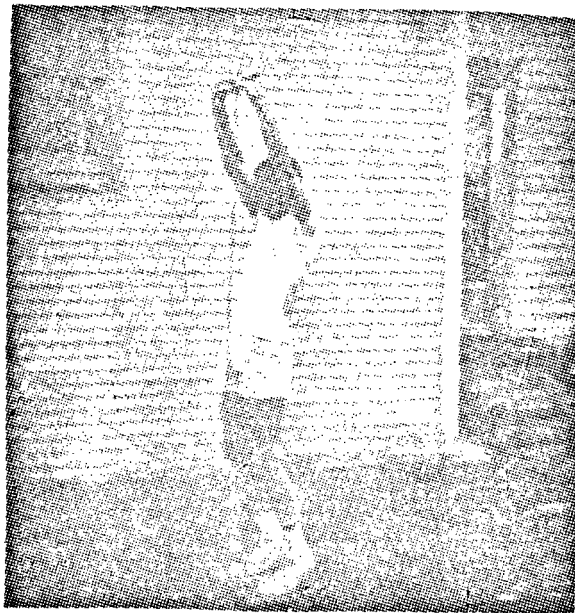
Side View of Big 4 Exercise that was used in this Study



Starting Position



Halfway Position



Finish Position

Appendix D

Appendix D

Front View of Big 4 Exercise that was used in this Study



Starting Position



Halfway Position



Finish Position