AN INVESTIGATION OF THE EFFECTS OF A SEASON OF VARSITY FOOTBALL OR BASKETBALL PARTICIPATION UPON HAND REACTION TIME OF HIGH SCHOOL ATHLETES

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by

Frank G. Nachtigal

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DEDICATION

To my wife, Helen, I dedicate this paper, for her assistance and constant encouragement.

Also, to the coaches and the athletes of Tonganoxie High, without whose help I could not have written this paper.

ACKNOWLEDGMENT

Appreciation is expressed to Dr. George Milton of the Department of Physical Education for his guidance and patience in the development and completion of this paper.

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CHAPTER I

INTRODUCTION

What is reaction time? Who possesses it? How do we use it? Because questions like these have been asked in many phases of education, and also in life, much research has resulted. Testing of theories and application of their results have led to many changes in the area of physical education and athletics. This is especially true in track and field competition where Westerlund and Tuttle studied the sprint start and concluded that the time required to leave the starting mark is of great importance in the sprint races.[1]

Reaction time is not the only requirement in sports competition, but it is a major mental factor to success in athletic contests. This is especially true for those contests which involve a high degree of coordinative movement. Louis Keller found that athletes participating in football, basketball, track, and baseball responded faster to a given stimulus than non-athletes under the same conditions.[2]

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[1]J. H. Westerlund and W. W. Tuttle, "Relationship Between Running Events in Track and Reaction Time," Research Quarterly, 2:95-100, April, 1931.

[2]Louis B. Keller, "The Relation Of Quickness of Bodily Movement to Success in Athletics," Research Quarterly, 13:146-155, May, 1942.

Exercises and drills which help individuals react more quickly to a situation have been the object of very extensive study in the last few years in programs of health, physical education, and athletics. Weight lifting, and more recently the trend toward isometric contractions, has been largely used to shorten reaction time in athletes.

The question remains, concerning a person's ability to move quickly, whether these exercises will affect his reaction time and speed of movement time. Much research needs yet to be done in the field of physiology of exercise to thoroughly answer this question. Research may well be a factor in helping people to become more efficient in whatever they attempt in life.

Wilken reports that being considered is the popular thought that isotonic and isometric exercising leads to slower muscular contractions, general reduction in speed of movement, and the muscle-bound state.[3] Wilken also states that in the minds of many physical education personnel muscle-boundness definitely results in loss of coordination and speed of movement due to "too many muscles."[4] His research reveals the following about the muscle-bound condition:

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[3]B. M. Wilkin, "The Effect of Weight Training on Speed of Movement," Research Quarterly, October, 1952, p. 361.

[4]Ibid.

1. Excessive development resulting in a shortening of muscles because of higher tonus.
2. Excessive size of the muscle, limiting the movement.
3. Greater viscosity.
4. Exceptionally higher tonus resulting in jerky, uncoordinated movements.[5]

Speed of reaction is needed to carry out daily tasks in virtually any occupation one might enter. This is necessary many times merely to avoid or prevent harm and injury. Factory workers are prime examples of this necessity. Loss of life may be prevented because of a quick reaction. Athletes require speed of reaction and speed of movement to play effectively and efficiently.

I. THE PROBLEM

Statement of the problem. The purpose of this study was to investigate the effect of a season of athletic participation upon hand reaction time of high school male athletes. These athletes participated in athletics at Tonganoxie High School, Tonganoxie, Kansas.

This study attempted to answer the following questions: (1) Will the reaction time of the dominant and

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[5]Ibid.

non-dominant hand be significantly improved by a single season of athletic participation in football or basketball? (2) Will the reaction time of the dominant and non-dominant hand be significantly improved by consecutive seasons of athletic participation in football and basketball?

This study was done to test the hypothesis that reaction time can be improved through the conditioning program and drills of participating in the duration of a season of football or basketball, or the combination of these sports.

Importance of the study. In the past, many studies have been undertaken to compare reaction time to success in athletics and success of skills in sports such as tennis, golf, and archery, to mention a few. Various studies have taken factors such as physical fitness, weight, height, competition and non-competition, and rewards, and noted results on reaction time.[6] To date, coaches, trainers, and athletes have not found a consistent way to shorten reaction time, as is testified by research.

Limitations of the study. This study included forty-one varsity football players and twelve varsity basketball players who participated in either or both of the sports at

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[6]Jimmie D. Brown, "An Investigation of the Effects of Isometric Finger Exercises Upon Hand Reaction Time of High School Freshmen" (unpublished Master's thesis, Kansas State Teachers College, Emporia, Kansas, 1967), p. 3.

Tonganoxie High School. The ages of the subjects ranged from fourteen to seventeen. The football participation was limited to eleven weeks and the basketball participation to sixteen weeks. Testing for reaction time included only the thumb and fingers of the right and left hand. Training included the conditioning received through drills and exercises of one season of participation in football, or basketball, or both.

II. DEFINITION OF TERMS USED

Football season of participation. For this study, football season will refer to the eleven weeks of practice, including nine regular season games.

Basketball season of participation. For this study, basketball season will refer to the sixteen weeks of practice, including sixteen regular season games plus those of regional tournament play.

Combination of seasons. Combination of seasons, for this study, will refer to the consecutive weeks of practice in football and basketball, including the contests of each sport.

Conditioning drills. Conditioning drills, in this study, refer to those exercises and drills used in football

and basketball to promote strength, gracefulness, and skill of executing patterns of play.

Nelson Reaction Timer. The Nelson Reaction Timer is designed to test reaction time, speed of movement, and response accuracy. It is a ruler-like stick that is marked off in portions equal to thousandths of seconds.

Reaction time. Reaction time is the time that elapses between the beginning of the stimulus and the beginning of the motor response.[7]

Dominant hand. The hand most used by the subject will be referred to as the dominant hand in this study.

Non-dominant hand. The hand least used by the subject will be referred to as the non-dominant hand for this study.

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[7]G. M. Scott, "Research Methods In Health, Physical Education, and Recreation," American Association for Health, Physical Education, and Recreation, May, 1959, p. 287.

CHAPTER II

REVIEW OF THE LITERATURE

Much material has been reported dealing with the various aspects of neuromuscular response. These studies vary from the measurement of the patellar or Achilles jerk, to the more complicated acts of conscious behavior. Most of the studies of conscious behavior involve the measurement of the time elapsing between the presentation of the stimulus and the response of the individual by movement of the finger or some other body appendage. Many studies also were found that attempted to measure the speed of a movement following the reaction time period.

It is the purpose of this chapter to present a summary of those studies which are related to (1) simple reaction time, (2) speed of movement time, and (3) reaction time and speed of movement time as a direct result of participating in a training program before testing.

I. LITERATURE ON REACTION TIME

Seventy-seven male students picked from the enrollment at the State University of Iowa were the subjects used by Burley in a study to determine the hand reaction time to simple and complex stimuli. These subjects ranged in age from eighteen to thirty-one and represented a good cross

section of the physically fit men of the activity program. Each subject was seated in front of a test key and was asked to place his hand on this key and to strike it when a light flashed. In a subsequent test the subjects were taught to respond to light number one only when it was preceded by lights number two, three, or four. The stimulus was varied but kept between one and four seconds. Burley concluded that: (1) all individuals react more slowly to complex stimuli than to a simple stimulus, and (2) reaction of all individuals to the complex stimuli were more variable than their reactions to the simple stimulus.[1]

Knapp compared the simple reaction times of twenty top-class racket players to twenty research students. Aged twenty to thirty, the sportsmen subjects were selected from international competitors in squash and badminton. The students were picked at random from the research department of Birmingham University in England. Each subject sat at a table with his finger on a key and was told to remove it when a light six inches in front of the key flashed. In this test muscular reaction was stressed to the subject in an orientation session. Twenty practice trials were given followed by a one minute rest and then twenty-five trials were given for score. The subjects were tested individually

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[1]Lloyd R. Burley, "A Study of the Reaction Time of Physically Trained Men," Research Quarterly, 15:232-239, October, 1944.

under the same conditions. Knapp found that the reaction times of the sportsmen were significantly shorter than those of the research students. Variation in reaction times of the sportsmen was less than that of the research students.[2]

In an attempt to study whether a significant difference in simple reaction time exists between the age groups of male high school students, Atwell and Elbel used two hundred and forty-seven subjects. These students, aged fourteen to seventeen, were tested for both hand reaction time and body response. The subjects were grouped by age for these tests. The hand reaction test was done with the subject sitting at a desk and his hand three and a half inches from a switch which he struck when the stimulus bell started to ring. The body response test was administered by having the subject stand on a line a measured distance from a switch on the wall which he moved toward to strike with his hand when a bell started to ring. This stopped the timing device which started simultaneously with the bell. Atwell and Elbel found a slight difference (not statistically significant) existed between the age groups in high school for hand response time with more rapid response with increased age. This was found to be true of the body

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[2]B. N. Knapp, "Simple Traction Times of Selected Top-Class Sportsmen and Research Students," Research Quarterly, 32:409-411, October, 1961.

response also. When compared to testing of University subjects, the University group mean was significantly faster.[3]

In a study by Hodgkins nine hundred and thirty men, women, and children ranging in age from six to eighty-four were used as subjects and tested to determine the difference between males and females of various ages in their speed of reaction time and speed of movement. The test consisted of the subject reacting to a visual stimulus at which time he removed his hand from a telegraph key and swung his arm horizontally to hit a padded rod. The subjects were the first, seventh, and tenth grades in the public schools of Santa Barbara and Boleta, California. College age subjects were volunteers from the University of California and Santa Barbara, California. All other subjects were volunteers from recreation clubs in Santa Barbara. Hodgkins found that (1) speed of both functions increases up to early adulthood and then decreases, and (2) peak speed is maintained longer by males in movement and longer by females in reaction time.[4]

In another study, Younger used one hundred and twenty-two subjects comprised of selected women athletes

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[3]William Atwell and E. R. Elbel, "Reaction Times of Male High School Students in the 14-17 Year Age Group," Research Quarterly, 19:22-29, March, 1948.

[4]Jean Hodgkins, "Reaction Times and Speed of Movement in Males and Females of Various Ages," Research Quarterly, 34:335-343, October, 1963.

and non-athletes at Michigan State University. The purpose of the study was to compare reaction time and arm movement times. Each subject was given thirty-five trials of which the last twenty were scored. Seated at a table, the subject was told to place a finger on a key and remove the finger and thrust the arm eleven inches forward to interrupt an electrical beam when a light beside the key was flashed. The tests were administered during the regular class periods between nine and four o'clock. The forty-seven women athletes, termed so because of varsity competition to their credit, were found to have significantly faster reaction and movement times than the non-athletes. Within the athletic group, tennis players, swimmers, fencers, and field hockey players do not differ significantly in reaction time.[5]

In a study by Norrie one hundred and two subjects were divided randomly into two groups and tested for reaction latency in simple and complex movements. The subjects, women from the college physical education classes of Berkley University, Berkley, California, were of an average age of nineteen and a half. All the subjects picked were right handed. Fifty-one subjects in Group I were tested for simple reaction movement and fifty-one subjects in Group II

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[5]Lois Younger, "A Comparison of Reaction and Movement Times of Women Athletes and Non-athletes," Research Quarterly, 30:349-355, October, 1959.

were tested for complex reaction movement. The testing tasks performed by the groups were fifty trials of the following:

> Group I. The subject placed a finger on a key and when a warning light flashed for the subject to be ready, another light soon came on which the subject reacted to by releasing the key and thrusting her arm forward and knocking down a barrier eleven inches in front of the key.
> Group II. Same as group one except before knocking down the barrier the subject contacted a rubber hose five inches to the right of the key and then a dummy button two and a half inches to the left of the key.

Norrie found that reaction time reaches its peak of performance earlier in simple movement than in complex movement.[6]

II. LITERATURE ON SPEED OF MOVEMENT TIME

Various theories as to what causes speed of movement may be found. Luke stated that either a boy is fast or he is not. Although one tends to associate the slimmer type of athlete with distance running where excess poundage would be a handicap, body build should not be the primary guide in making the selection of sprinters or distance runners.[7]

Miller, using data on a sixty yard dash, concurred that speed is an innate factor which is not significantly

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[6]Mary Lou Norrie, "Practice Effects on Reaction Latency for Simple and Complex Movements," Research Quarterly, 38:79-85, March, 1967.

[7]Brother G. Luke, F. S. C., Coaching High School Track and Field (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1958), p. 40.

related to body size or build. He selected at random 1,559 pretest records from some 6,000 which were collected during the academic year of 1942-43. He felt that perhaps the heavier individuals accommodate increased weight by an increase in strength.[8]

The speed of a lateral arm movement and the strength mass ratio were measured by Clarke in forty-eight university student volunteers enrolled in elementary physical education classes. Clarke also found that the ability to exert muscular strength in a coordinated manner is determined by a specific neuromuscular pattern. Knowledge of the muscular strength cannot be used to predict successfully the speed of an arm movement. He found the correlation in movement time and reaction time to be low ($r=.045$).[9]

Henry, in a study of increase of speed of movement by motivation and by transfer of motivated improvement, used ten experimental and ten control subjects. The experimental group exhibited a transfer effect of 12 per cent on a retest of a relatively complicated movement after a period of materialization by applying a mild electric shock during the

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[8]K. D. Miller, "A Critique on the Use of the Height-Weight Factors in the Performance Classification of College Men," Research Quarterly, 23:402, December, 1952.

[9]David H. Clarke, "Correlation Between the Strength Mass Ratio and the Speed of an Arm Movement," Research Quarterly, 31:570-574, December, 1960.

slower responses of a simple movement. The control group showed no statistically significant transfer from unmotivated practice with the simple movement. The resulting improvement of the experimental group was considered more likely to be due to transfer of the motivation effect rather than to transfer of learning.[10]

Thompson, Nagle, and Dobias conducted studies to measure movement time of forty-three Boston University varsity football players and forty New Hampshire High School football lettermen in response to selected starting signals. Each group was tested on two starting counts, rhythmic and non-rhythmic. Both groups reacted more quickly to the starting signals which allowed the subjects to concentrate on the response rather than the stimulus. The rhythmic digit starting signals permitted the fastest movements, .51 seconds for college players and .54 seconds for high school football players. Non-rhythmic word digit and non-rhythmic color signals were investigated and found to result in slower reaction and speed of movement times.[11]

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[10]Franklin M. Henry, "Increase in Speed of Movement by Motivation and by Transfer of Motivated Improvement," Research Quarterly, 22:219-228, 1951.

[11]E. W. Thompson, F. J. Nagle, and R. Dobias, "Football Starting Signals and Movement Times of High School and College Football Players," Research Quarterly, 29:222-230, June, 1958.

III. LITERATURE ON REACTION TIME AND SPEED OF MOVEMENT TIME AS A RESULT OF PARTICIPATION IN A TRAINING PROGRAM

Gollnick, Hearn, and Tweit tested twenty-six male college freshmen of low fitness (according to the Rogers Physical Fitness Index) before and after six weeks of vigorous physical training. This study was to determine whether total body reaction time could be improved as a result of vigorous physical training. The subjects, between the ages of seventeen and twenty-one, participated in three weeks of a battery of vigorous exercises designed to develop large muscle groups and in three weeks of playing speedball, relays, sprints, and weight training. Before the initial test was administered, each subject was familiarized with the testing procedure to reduce any learning which might occur with practice. Gollnick and partners concluded from the results of this investigation that it appears total body reaction can be improved by training.[12]

In a study to determine the effects of large amounts of exercise on the reaction time and speed of movement, seventy-five college students from the activity program were selected and tested by Phillips. The subjects were divided

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[12]P. D. Gollnick, G. R. Hearn, and A. H. Tweit, "Effect of Training Programs on Total Body Reaction Time of Individuals of Low Fitness," Research Quarterly, 34:508-514, December, 1963.

randomly into three groups of twenty-five each and did the following before being tested: Group C, or the control group, merely rested for ten minutes and then was tested; Group A's exercise was to turn a two-handed low friction vertical crank for two and one-half minutes after resting seven and a half minutes, and then be tested; and Group S exercised for ten minutes by stepping up and down on a stool at the rate of sixty step-ups per minute. The lead foot (changed every thirty seconds) always remained on the stool. For this stool stepping exercise a visual metronome established the cadence. One hand rested on a horizontal bar to prevent the subject from falling as he became tired. The reaction time and movement time test used consisted of the subject placing his index finger on a key and striking a target eleven inches away when the stimulus light was presented. For this the subject sat in a comfortable position at a table with his arm bent approximately one hundred sixty-five degrees so that he had freedom of movement. Phillips found that reaction time is evidently not influenced by heavy warm-up exercises that do improve speed of movement. He also concluded that reaction time and speed of movement are substantially uncorrelated.[13]

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[13]W. H. Phillips, "Influence of Fatiguing Warm-up Exercises on Speed of Movement and Reaction Latency," Research Quarterly, 34:370-378, October, 1963.

In a study by Berger to determine the effects of weight training upon vertical jumping ability, eighty-nine college males in the activity program were employed as subjects. All subjects met three times weekly for seven weeks for a general condition program in addition to the experimental training program. Each subject was initially administered a vertical jump test composed of the distance from ground level to jump and reach level. Initial and final testing procedures were identical and were the following: right side of the body to wall, a vertical jump was performed from a crouched position without any steps just before the jump. The best one of three jumps was used as the jump performance for each subject. Following the initial test the subjects began one training program of the following:

Group I. Trained dynamically with deep knee bend exercises for 10 RM for 10 repetitions.
Group II. Trained dynamically 50-60% load of Group I with deep knee bends exercise of Group I in 10 RM for 10 repetitions.
Group III. Trained statically in position one with upper leg in parallel position with floor, second with legs fixed at approximately 135 degrees.
Group IV. Performed 10 vertical jumps daily.

Berger found that the main difference between initial and final jumping tests indicates that group I, II, and IV did improve significantly. These groups are classified as the dynamic groups. Group III, or static, did improve but not significantly. Berger concluded that dynamic overload

training is more effective for increasing vertical jump ability than load training.[14]

Chui, stating that little attention had been focused on determining which training method was most influential in causing a significant increase in limb speed, compared the effects of isometric and dynamic weight training exercises on strength and speed of single discreet movements. In his study he used seventy-two male subjects who elected to enroll in a weight training activity section and twenty-four subjects enrolled in another activity section who performed no weight training exercises of any sort. He found that significant gains in limb strength, resulting from performing resistive and non-resistive exercises in a specific range of movement, were accompanied by significant gains in speed of the same movement. Since the difference in strength and speed gain between exercise regimens was non-significant, both training methods appeared to be equally effective.[15]

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[14]Richard A. Berger, "Effects of Dynamic and Static Training on Vertical Jumping Ability," Research Quarterly, 34:419-424, December, 1963.

[15]Edward F. Chui, "Effects of Isometric and Dynamic Weight Training Exercises Upon Strength and Speed of Movement," Research Quarterly, 35:246-257, March, 1964.

SUMMARY

Summary. Studies on reaction time have shown that athletes possess shorter reaction times than non-athletes. This has shown to be true of both men and women. Successful participation in athletics has also been found to be closely related to reaction time. While differences in reaction time have been found, the exact reasons remain unknown.

CHAPTER III

PROCEDURES

The purpose of this study was to ascertain the effect of a season or more of varsity athletic participation upon the hand reaction time of high school males. The subjects for this study were athletes of Tonganoxie High School.

The Nelson-Reaction Time test was administered to fifty-three subjects as a measure of reaction time of hand to a sight stimulus. An initial test was given to all football players on the day they reported and checked out football suits and a final test was administered the day after the last season game. Those who participated in basketball following a season of football participation were given the identical test after the last basketball game of the basketball season. Those subjects who participated only in basketball took an initial test on the day basketball drills began and the final test at the close of the basketball season. The results of the tests were subjected to analysis of t tests following all testing.

Subjects. The subjects of this study consisted of fifty-three freshmen, sophomores, juniors, and seniors aged fourteen to seventeen who elected to participate in varsity football and basketball during 1967-68 at Tonganoxie High School. All practice drills were held after a full day of

six classroom periods and lasted approximately two hours. Only those subjects who had participated in the full season of football or basketball were employed as subjects for this study. Football subjects participated in eleven weeks of drills while basketball subjects participated in sixteen weeks of drills. Drills on the varsity level of football and basketball consisted of warm-up calisthenics to build strength, and drills designed to build player competence in the offensive and defensive aspects of the respective sport.

The subjects were divided into four groups for comparison purposes. Group I consisted of twenty-two subjects who were centers, guards, or tackles on the varsity football team. Group II consisted of nineteen subjects who were backfield or split-end personnel on the varsity football team. Group III comprised subjects who played basketball only. This number was twelve of the total subjects. Group IV was twenty-four subjects who participated in both varsity football and basketball consecutively.

Experimental apparatus. The equipment necessary for this study was (1) the Nelson Reaction Timer Model RT-2, and (2) a study hall desk commonly found in most high schools. The Nelson Reaction Timer looks much like a yard stick. Instead of being marked off in inches, the Nelson Reaction Timer is marked off in thousandths of a second portions. The desk used was a combination of a chair plus a slightly

sloping desk top fastened to the right side of the chair so the subject could slide in from the left side to sit down. The desk top has about three square feet of area where the subject could comfortably place his hand and arm for the reaction time tests.

Testing procedure. The Nelson Reaction Timer was used in the hand reaction test in this study. Forty-one subjects were tested initially the day before football drills began. Testing took place in a windowless locker room next to the gymnasium where the subjects would not be distracted by surrounding activity. Only the subject and the tester were present in the room. The subject entered the test room and presented the tester an information sheet stating name, age, and dominant hand. Subjects were further oriented by being informed of the hand reaction test involving the Nelson Reaction Tester. Each subject comfortably placed his forearm and hand on the desk, holding his thumb and forefinger one inch apart in a horizontal plane. The tester held the reaction timer near the top and suspended it between the subject's thumb and forefinger so that the "base line" located at the bottom end of the tester was held level with the upper edge of the subject's thumb. The subject was instructed to pinch the reaction timer when he saw the "base line" move downward. The subject was instructed to look at the black lined zone and only pinch the reaction timer when

this area moved, and not pinch in anticipation of movement. As recommended by Rush, the time interval prior to the stimulus (the dropping of the reaction timer stick in this study) was varied but kept between one and four seconds.[1] The forty-one subjects were administered a final test identical to the initial test the day after football season ended. Those who participated in varsity basketball were also tested initially the day basketball drills began and finally on the day the season ended. Those subjects who participated in basketball and football had their final test of football season serve as the initial test of basketball participation because the seasons were a day apart in ending and beginning.

All subjects were given three practice trials after which ten trials for score were recorded for each hand. The three fastest of the ten scores were discarded as being the result of possible anticipation. The three slowest scores were discarded as being the result of possibly being caught in a trough of attention. The four remaining scores were then averaged in order to determine the subject's average reaction time.

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[1]Floyd L. Rush, Psychology and Life (Chicago: Scott Foresman Co.), p. 464-470.

CHAPTER IV

PRESENTATION OF DATA

I. INTRODUCTION

It was the purpose of this study to determine the effects of a single season or consecutive seasons of athletic participation upon the hand reaction time of high school male athletes.

The analysis of data was based on the mean gain of reaction time for the dominant and non-dominant hand of each group resulting from an initial reaction time test before and a final reaction time test immediately following a single season or consecutive seasons of athletic participation.

The statistical method of computation was the determination of the mean differences of the dominant and non-dominant hand of each group after an initial and final test of hand reaction time. The *t* test for significance was employed to determine whether the groups were significantly different at the conclusion of this study in hand reaction time. The *t* test was employed for mean gain by both the dominant and non-dominant hand reaction times. The *t* test was used on the correlated means between the initial and final hand reaction time test scores.

II. SIGNIFICANCE OF THE MEAN GAINS MADE BY EACH GROUP

Dominant Hand. Group I represents participants who were centers, guards, and tackles during the football season. The linemen were separated from the backfield personnel for the purpose of investigating the theory that backfield personnel are quicker in reaction time. The initial mean as shown in Table I was .209 as compared to a final mean reaction time of .184. This is a difference of .025 or a decrease in reaction time after a season of athletic participation. The standard error of difference was computed at .004. The t score of 1.61 was not significant at the .05 level of confidence. A t of 2.20 was necessary to show significance with 11 degrees of freedom at the .05 level of confidence. The score in this instance indicates that a season of football participation does not significantly improve right hand, or dominant hand, reaction time of guards, centers, and tackles.

The initial mean of Group II, those who were classified as backfield and split ends during football participation, was .203 and the final mean was .178. The standard error of the difference was computed at .004 which yielded a non-significant t of 1.24. Again a t of 2.20 was needed for significance at the .05 level of confidence.

Group III, participants in basketball only, had an initial mean of .191 and a final mean of .192. The standard error of difference was .007 which represents a *t* of .885 which is a non-significant difference.

Group IV, those who participated in consecutive seasons of football and basketball, was the only group which made a significant improvement on the right hand reaction time tests. Their initial mean score was .203 and their final was .197. The standard error of the difference was .004 which yielded a significant *t* of 2.18. The *t* surpassed the needed *t* of 2.07 at the .05 level but fell short of 2.81 required for confidence at the .01 level with 23 degrees of freedom.

TABLE I

SIGNIFICANCE OF GAIN BETWEEN THE INITIAL AND FINAL REACTION TIME TESTS FOR THE DOMINANT HAND

Group	N	Initial Mean	Final Mean	Diff.	S. E. Diff.	*t*	P
I	22	.209	.184	.025	.004	1.61	---
II	19	.203	.178	.025	.004	1.24	---
III	12	.191	.192	-.001	.007	.885	---
IV	24	.203	.197	.004	.004	2.18	.05

t needed with 11 df at .05 = 2.20
t needed with 11 df at .01 = 3.11
t needed with 23 df at .05 = 2.07
t needed with 23 df at .01 = 2.81

Non-dominant Hand. Group I's initial mean was .213 as compared with a final mean reaction time of .190. This is a difference of .023 or a decrease of reaction time. The standard error of difference was computed at .0039. The t score of 5.76 was significant at the .01 level of confidence as at least a t of 2.83 was needed. The t indicates the non-dominant hand reaction time of the subjects was improved significantly as a result of football participation.

The initial mean of Group II was .208 while the final mean was .187. The standard error of difference .0036 yielded a significant t of 5.83.

Group III had an initial mean of .191 and a final mean of .199. This is a difference of -.008. The standard error of difference was computed at .021 which resulted in a t score of 4.36. This notes a significant difference of the left hand of the basketball participants.

Group IV's initial mean of .208 when compared to their final mean of .200 reveals a difference of .008. The standard error of the difference was computed at .003 which yielded a significant t of 2.67 at .05 level of confidence. Group IV's non-dominant hand reached significance at the .05 level but fell short of the .01 level.

TABLE II

SIGNIFICANCE OF GAIN BETWEEN THE INITIAL AND FINAL REACTION TIME TESTS FOR THE NON-DOMINANT HAND

oup	N	Initial Mean	Final Mean	Diff.	S. E. Diff.	t	P
I	22	.213	.190	.023	.0039	5.76	.01
II	19	.208	.187	.021	.0036	5.83	.01
III	12	.191	.199	-.008	.021	4.36	.01
IV	24	.208	.200	.008	.003	2.67	.05

t needed with 21 df at .01 = 2.83
t needed with 18 df at .01 = 2.88
t needed with 11 df at .01 = 3.11
t needed with 23 df at .05 = 2.07

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to investigate the effect of a season or more of varsity athletic participation upon the hand reaction time of high school males. Their ages ranged from fourteen to seventeen. The varsity sports involved were football and basketball. The football season duration was eleven weeks of practice which included nine season games. The basketball season consisted of sixteen weeks of practice including sixteen regular season games plus six tournament games.

For this study, fifty-three subjects divided into four groups, were employed. Group I consisted of the centers, guards, and tackles of the football team. Group II were the backs and split-ends on the football team. Group III were those players of the basketball squad who participated in basketball only. Group IV included all participants who were both football and basketball squad members. The subjects of this study were varsity squad members at Tonganoxie High School, Tonganoxie, Kansas.

Each subject was given an initial hand reaction test prior to the season of athletic participation and a final test immediately following the close of that particular

season. The test consisted of the Nelson Reaction Timer to determine the hand reaction time scores.

The results of the initial and final tests were used to make a statistical analysis of reaction time gains made by the subjects. The *t* test was employed to determine if significant improvement had been made.

I. FINDINGS

The findings of the study were as follows:

1. Participation as a lineman (Group I) in a season of football did improve dominant hand reaction time but not to a significant level. Non-dominant hand reaction time was significantly improved to the .01 level of confidence.
2. Participation as a split-end or backfield man (Group II) in a season of football did improve right dominant reaction time but not significantly. Non-dominant hand reaction time was significantly improved to the .01 level of confidence.
3. Participation in only a season of basketball (Group III) did not improve either dominant or non-dominant hand reaction time.
4. Participation in consecutive seasons of football and basketball improved dominant and left-hand reaction time to the significant .05 level of confidence.

II. CONCLUSIONS

Within limitations of this study the conclusions following are justified.

1. A single season of athletic participation does not significantly improve dominant hand reaction time.
2. A single season of football participation does significantly improve non-dominant hand reaction time.

3. A single season of basketball participation does not significantly improve either dominant or non-dominant hand reaction time.
4. Participation in consecutive seasons of football and basketball will significantly improve both dominant and non-dominant hand reaction time.

III. RECOMMENDATIONS FOR FURTHER STUDY

1. A study of college athletics employing the identical research design would shed light on the effects of athletics on hand reaction time.
2. The testing of all subjects concurrently, that is, at the beginning of school and then again before the actual activity began would be helpful in determining the full effects of school activities upon hand reaction time.
3. The addition of a control group not involved in athletics, but participating in school activities such as band, pep squad, drama, and industrial arts.
4. The testing of subjects at the beginning of summer vacation to determine effects of summer activities on groups before participation in athletics.
5. Broadening the study to include effects upon hand reaction time made by activities such as track, tennis, and swimming.

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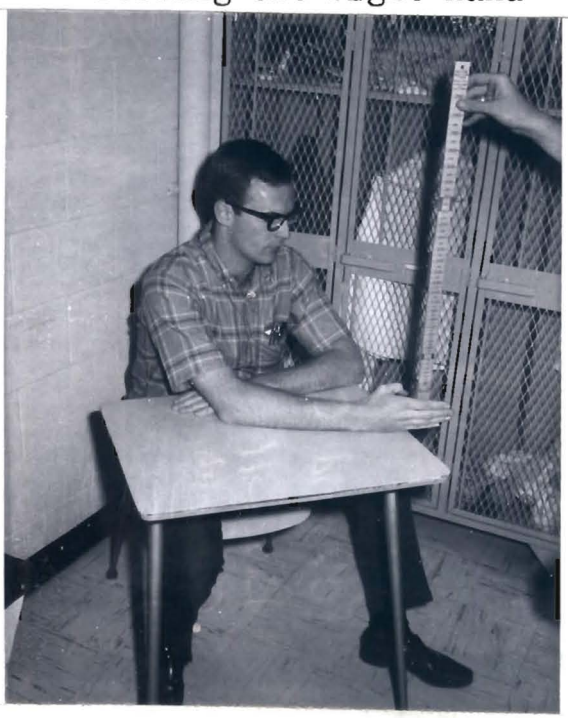
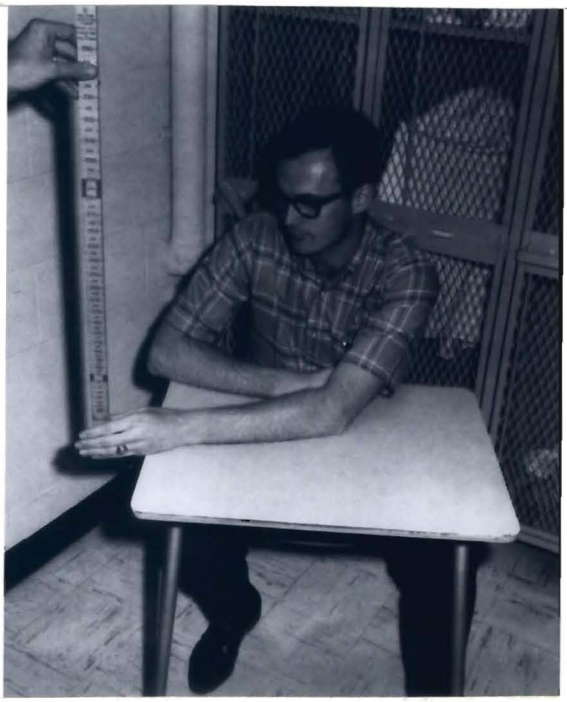
APPENDIX

APPENDIX A

Picture 1
Testing the right hand



Picture 2
Testing the left hand



Picture 3
Nelson Reaction Timer

APPENDIX B

GROUP I
FOOTBALL PARTICIPANTS WHO WERE CENTERS, GUARDS, AND TACKLES

Subject	Left Hand		Right Hand	
	Initial	Final	Initial	Final
101	.203	.163	.179	.153
102	.213	.211	.205	.149
103	.209	.211	.200	.183
104	.198	.182	.199	.178
105	.229	.194	.216	.215
106	.219	.181	.205	.196
107	.229	.198	.219	.173
108	.210	.160	.198	.191
109	.231	.170	.228	.185
110	.225	.224	.241	.219
111	.206	.205	.195	.198
112	.235	.240	.254	.238
113	.228	.196	.203	.196
114	.195	.171	.209	.158
115	.199	.190	.224	.179
116	.226	.194	.221	.179
117	.186	.179	.206	.160
118	.224	.188	.223	.186
119	.216	.173	.188	.170
120	.204	.194	.196	.185
121	.183	.184	.185	.162
122	.218	.181	.211	.186

GROUP II
FOOTBALL PARTICIPANTS WHO WERE BACKS AND SPLIT-ENDS

Subject	Left Hand		Right Hand	
	Initial	Final	Initial	Final
201	.215	.215	.215	.200
202	.204	.186	.194	.179
203	.180	.159	.161	.149
204	.225	.241	.238	.232
205	.205	.180	.183	.178
206	.205	.173	.190	.163
207	.209	.174	.208	.159
208	.198	.150	.175	.156
209	.219	.184	.239	.173
210	.205	.196	.205	.185
211	.211	.196	.204	.199
212	.205	.210	.205	.189
213	.209	.186	.213	.193
214	.210	.186	.215	.173
215	.214	.178	.195	.159
216	.205	.194	.216	.166
217	.205	.193	.193	.165
218	.195	.144	.183	.158
219	.231	.210	.228	.208

GROUP III
THOSE WHO PARTICIPATED IN ONLY BASKETBALL

	Left Hand		Right Hand	
Subject	Initial	Final	Initial	Final
301	.188	.218	.199	.199
302	.183	.187	.184	.183
303	.210	.201	.208	.180
304	.209	.216	.204	.194
305	.175	.183	.218	.165
306	.190	.191	.190	.194
307	.178	.183	.179	.200
308	.188	.209	.186	.204
309	.206	.218	.180	.218
310	.180	.189	.189	.190
311	.199	.188	.173	.180
312	.183	.209	.183	.201

GROUP IV
THOSE WHO PARTICIPATED IN CONSECUTIVE SEASONS
OF FOOTBALL AND BASKETBALL

Subject	Left Hand		Right Hand	
	Initial	Final	Initial	Final
401 (113)	.228	.216	.203	.210
402 (114)	.195	.195	.209	.210
403 (115)	.199	.193	.224	.174
404 (118)	.224	.210	.223	.219
405 (119)	.216	.213	.188	.204
406 (120)	.204	.219	.196	.215
407 (121)	.183	.174	.185	.164
408 (122)	.218	.181	.211	.180
409 (202)	.204	.201	.194	.205
410 (203)	.180	.185	.161	.180
411 (204)	.225	.213	.238	.201
412 (205)	.205	.191	.183	.190
413 (207)	.209	.181	.208	.199
414 (208)	.198	.193	.175	.196
415 (209)	.219	.225	.238	.214
416 (210)	.205	.205	.205	.199
417 (211)	.211	.214	.204	.200
418 (212)	.205	.219	.205	.213
419 (213)	.209	.199	.213	.200
420 (214)	.210	.209	.215	.208
421 (215)	.214	.191	.195	.181
422 (217)	.205	.159	.193	.183
423 (218)	.195	.168	.183	.160
424 (219)	.231	.250	.228	.230