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A study of the reaction time of high school defensive football players.

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Thesis

A STUDY OF THE REACTION TIME OF HIGH SCHOOL DEFENSIVE FOOTBALL PLAYERS

Submitted by

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CHAPTER I

INTRODUCTION

Each year the football coach faces the dilemma of selecting material for his squad. There are years when he has a wealth of material returning, therefore lessening his problems. However, most years the coach is confronted with many problems.

From experience, most coaches will agree that line backerups are difficult to find and the time lost experimenting with various candidates for this all-important position is great.

It is understood that quick reaction time does not solely determine good backerups. Many other factors must be considered, however, but the coach must begin somewhere.

The purpose of this study is to attempt to provide another instrument for the coach to aid him in selecting the most promising material.

CHAPTER II

Statement of the problem.-- A study of reaction time of large muscle groups in football players for the purpose of selecting backerup candidates.

Justification of the study.-- It is felt that much valuable time is lost each year by coaches experimenting with different players in the backerup positions, unless he is fortunate enough to have numerous veterans returning, which more than likely is not the case. Time is an important factor in coaching football as in any sport, and therefore by using this reaction time device it is intended to take some of the "guessing" and "trial and error" methods out of selecting backerups. W. R. Miles[1/] states:

> "We delude ourselves if we imagine that the coach, unaided by instruments, can arrive at perfectly objective and non-partisan selections. Human judgment shows a strong tendency to accentuate minor items and these may or may not be generally representative of a given man's quality or performance. Instrumental measurement is likely to be less biased but obviously even these results should not be followed blindly."

The writer realizes that many other factors enter into the picture before it can be said, "This person is the man for the job." Some of the factors involved are condition,

1/ W. R. Miles, Individual and Group Reaction Time in Football Charging, Research Quarterly (October, 1931), 2:3-13.

courage, desire, emotional and mental stability.

The need for testing in the field of physical education and athletics has been recognized by leaders for a long time. Coleman Griffith[1/] wrote, "To know how to select from a dozen candidates the right man for the right place, to know how to plan a season, these are some of the things that belong to the psychological side of athletics."

The writer found that most reaction time tests relied only on hand responses. It was first believed that if a person was quick in one thing, as in moving the hand, this was an indication of all other motor performances. We now realize this does not hold true in the vast majority of cases. Using this idea as the basis of the study, the writer set up the testing to simulate actual game conditions. This required whole body movement in recording reaction time.

1/ C. R. Griffith, Psychology and Athletics, C. Scribner and Sons, New York, 1928, pp. 16-17.

CHAPTER III

REVIEW AND ANALYSIS OF THE LITERATURE

Literature concerning reaction time.— In recent years a number of studies of reaction time have been made in the field of physical education and athletics.

The writer found in reviewing reaction time that a hand response does not necessarily represent all motor responses and tried to make the test as close to game conditions as possible. This required whole body movement in recording reaction time.

Olsen[1] states: "Reaction time is the time that elapses between the beginning of the stimulus and the beginning of the motor responses." He continues, "The time from beginning contraction to completion of movement defines speed of movement." While the former may be a definition of true reaction time, it would be extremely difficult to measure the beginning of a motor response. The writer found that most experimenters made use of some kind of motor performance in determining length of reaction time.

1/ Einar Arthur Olsen, "The Relationship Between Certain Psychological Capacities and Success in College Athletics," Doctors Dissertation, 1952.

Miles[1] conducted reaction time experiments on football players. He devised a chronograph which recorded the reaction times of seven men at once, which measured the men under conditions resembling those of actual play. Olsen[2] notes that Miles reported a considerably longer reaction time (average 389 milliseconds) than that reported by psychologists using a hand response key. This was probably due to the large muscle groups involved in Miles'[3] experiment which required entire body movement. Miles[4] states, "It was first assumed that if a man was quick in one thing, such as moving hand or finger, this score was taken as a representative of his speed in other motor performances. Now we find from the careful testing of many individuals on a wide variety of measurement that one score must not be trusted for all." Miles[5] goes on to say, "New instrumental aids will make it increasingly possible for the good coach to so select his "timber" that the resulting athlete will be competing in those games or events for which he has good natural and

1/ W. R. Miles, Individual and Group Reaction Time in Football Charging, Research Quarterly (October, 1931), 2:3, pp. 5-13.

2/ Olsen, Op. Cit.

3/ Miles, Op. Cit.

4/ Miles, Op. Cit.

5/ Miles, Op. Cit.

trained capacity."

Westerlund and Tuttle[1] in their study of reaction time in track, using a finger response testing device came to the following conclusion: "There is a high degree of relationship between speed in running seventy-five yards and reaction, the coefficient being .863."

Lautenbach and W. W. Tuttle[2] in their study proved that there is a significant relationship between voluntary response as measured by reaction time and involuntary response as measured by reflex time in the same events. Measuring the reflex time of the knee jerk they came to the following conclusion: "There is a high degree of relationship between reflex time and speed in sprinting, the coefficient of correlation is .815."

Burley[3] reports a significantly faster reaction time among baseball and basketball players than among football linemen and football backs.

Burpee and Stroll[4] state, "In sports we need to know not only how quickly he can react by pressing a key but also with

1/ J. H. Westerlund and W. W. Tuttle, "Relationship Between Running Events and Reaction Time," Research Quarterly (October, 1931), 2:3, pp. 95-100.

2/ R. Lautenbach and W. W. Tuttle, "Relationship Between Reflex Time and Running Events in Track," Research Quarterly (October, 1932), 3:3, pp. 138-143.

3/ L. R. Burley, A Study of the Reaction Time of Physically Trained Men, Research Quarterly (March, 1937), 8:133-142.

4/ R. H. Burpee and W. Stroll, Measuring Reaction Time of Athletes, Research Quarterly (March, 1936), 7:1, pp. 110-118.

what speed and accuracy he can move six to ten feet in catching a ball, tagging out a player, hitting a puck, tennis ball, hand ball, or volley ball." They continue, "Although several splendid attempts have been made to isolate the factors involved in attaining success in physical education activities, few if any have attempted to measure the importance of reaction time. This is largely because suitable apparatus has not usually been available."

Beise and Peasely[1/] found that "In comparing reaction time of large muscle groups with analogous movement of the arms, it was found that the reaction time of the arms was much faster." They also found that a subject who has fast reaction time of legs does not necessarily have fast reaction time of arms, or vice versa.

Keller[2/] used 359 athletes in his study of quickness of bodily movement. He found there is a positive relationship between the ability to move the body quickly and success in athletic activities. He further states, "Men who are not quick enough to achieve proficiency and success in highly competitive team games might be guided into the more individual type of sports and possibly become outstanding performers."

1/ D. Beise and V. Peaseley, The Relation of Reaction Time, Speed, and Agility of Big Muscle Groups to Certain Sport Skills, Research Quarterly (March, 1937), 8:133-142.

2/ L. F. Keller, The Relation of Quickness of Bodily Movement to Success in Athletics, Research Quarterly (May, 1942), 13:146-155.

Morehouse and Miller[1], Scott[2], and Bowen and McKenzie[3] state in their texts that accuracy of movement is essential in all skills and that the accuracy involves coordination of eye and muscle.

Krakower[4] states: "Testing is important if it is given correctly and by qualified person, and used correctly such as checking on individual or a group with another individual or groups."

Gray[5] attempted to evaluate "reaction time with choice" as an element in a laboratory test intended to measure motor ability. Simple reaction time is probably too uniformly developed to afford a means of discrimination among individuals. A much greater range of scores is obtained upon introducing the element of choice because the higher mental functions of discrimination, decision, and judgment are involved."

Patrick[6] states that a player needs quick reaction time

1/ L. Morehouse and A. Miller, Physiology of Exercise, Mosby Co., St. Louis, 1948, pp. 236-238.

2/ M. G. Scott, Analysis of Human Motion, Crofts and Co., New York, 1947.

3/ W. P. Bowen and R. T. McKenzie, Applied Anatomy and Kinesiology, Len and Febiger, Philadelphia, 1947.

4/ H. Krakower, "Testing - Overdone or Underdone," Journal of Health and Physical Education (May, 1942), 13:285.

5/ L. F. Gray, Reaction Time with Choice as an Element of Motor Ability, Research Quarterly (March, 1938).

6/ J. Patrick, "Quick Reaction Time Means Athletic Ability," Athletic Journal (September, 1949), pp. 30-68.

to meet opportune situations. He further states, "Quick reaction time is considered to be an important earmark of a good athlete."

Erickson[1] relates, "The relationship between reaction time and success in athletes is a point of controversy and is not definite, although some studies indicate a positive relationship between the two."

Glassow[2] mentions the fact that coaches have used motion pictures for years and are still investigating other methods of using their films.

McGuirk[3] states, "The general aim of analyzing movies of a game is three-fold: first, to locate and remedy the weak spots in their own team; second, to discover opponents' plays that are worth utilizing in their own offense; and third, to attempt to locate the weaknesses of the opponents in order to apply this knowledge at the next game."

A fourth step can be added with the use of films for a measuring stick to aid the coach in selecting his material.

1/ C. E. Erickson, "A Study to Determine the Relationships Between Certain Psychological Capacities and Success in Coaching Football," Doctors Dissertation, Boston University, 1953, pp. 44-45.

2/ R. B. Glassow, "Motion Pictures as Teaching Aids," Journal of Health and Physical Education (October, 1942), 13:463.

3/ Warren P. McGuirk, "A Study of the Use and Value of Motion Pictures as Used in Coaching Football," Masters Thesis, 1949.

Olsen[1] in his analysis of reaction time experiments states: "The differences between the groups of skilled athletes are not well defined, and before any standards can be established more research is needed. The relationship between reaction time and success in specific athletic skills is not definite. Although some studies indicate a positive relationship between the two, more objective methods of determining athletic success need to be utilized."

1/ Olsen, Op. Cit.

CHAPTER IV

TECHNIQUES AND PROCEDURES

Introduction.— This study was carried on during January and February, 1954. A total of thirty football players were tested, consisting of nine sophomores, fifteen juniors and six seniors. The age of the candidates ranged from fifteen years-four months to eighteen years-nine months.

Group.— The group consisted of thirty football candidates with a variance in experience from sophomores to seniors. The candidates tested not only represented backs, but all positions on the team.

Test.— The test consisted of four series of four responses each, totalling sixteen responses. Each series had one play to the right, designating end run to right, left, forward (buck or dive play), and back (forward pass). Each candidate was allowed one practice play and received the same instructions.

The instrument.— The apparatus consisted of a projector, screen, special film, photo cell, control box, clock, four inclined plane switches. The entire area covered is approximately sixteen feet by eight feet.

Projector - Sixteen millimeter with a conventional screen

Special Film - Specially spliced football plays consisting

of seventeen plays: one practice play, four right end sweeps, four left end sweeps, four bucks up the middle, four forward passes

Control Box - Contains four switches, one connected to each of the four inclined plane switches. The control box is switched to the correct inclined plane switch so that when the candidate steps on the switch it stops the clock.

Clock - The face of the clock is divided into hundredths of a second and goes once around for one second.

Incline Plane Switches - The center of the platform has a switch controlled by a heavy spring and when the spring is compressed it cuts the switch and therefore stops the clock.

Figure 1. General Draft

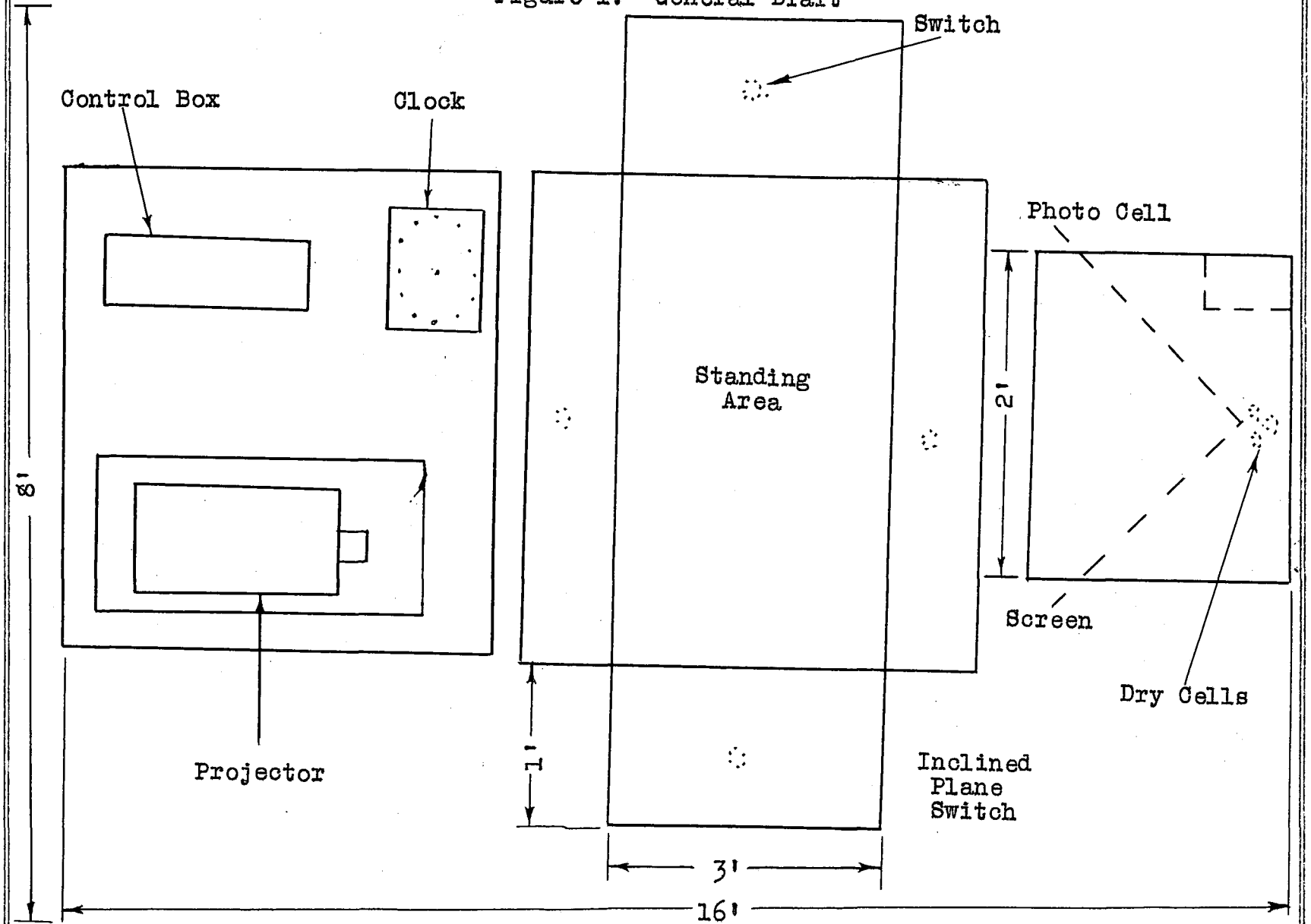


Figure 2. Control Box

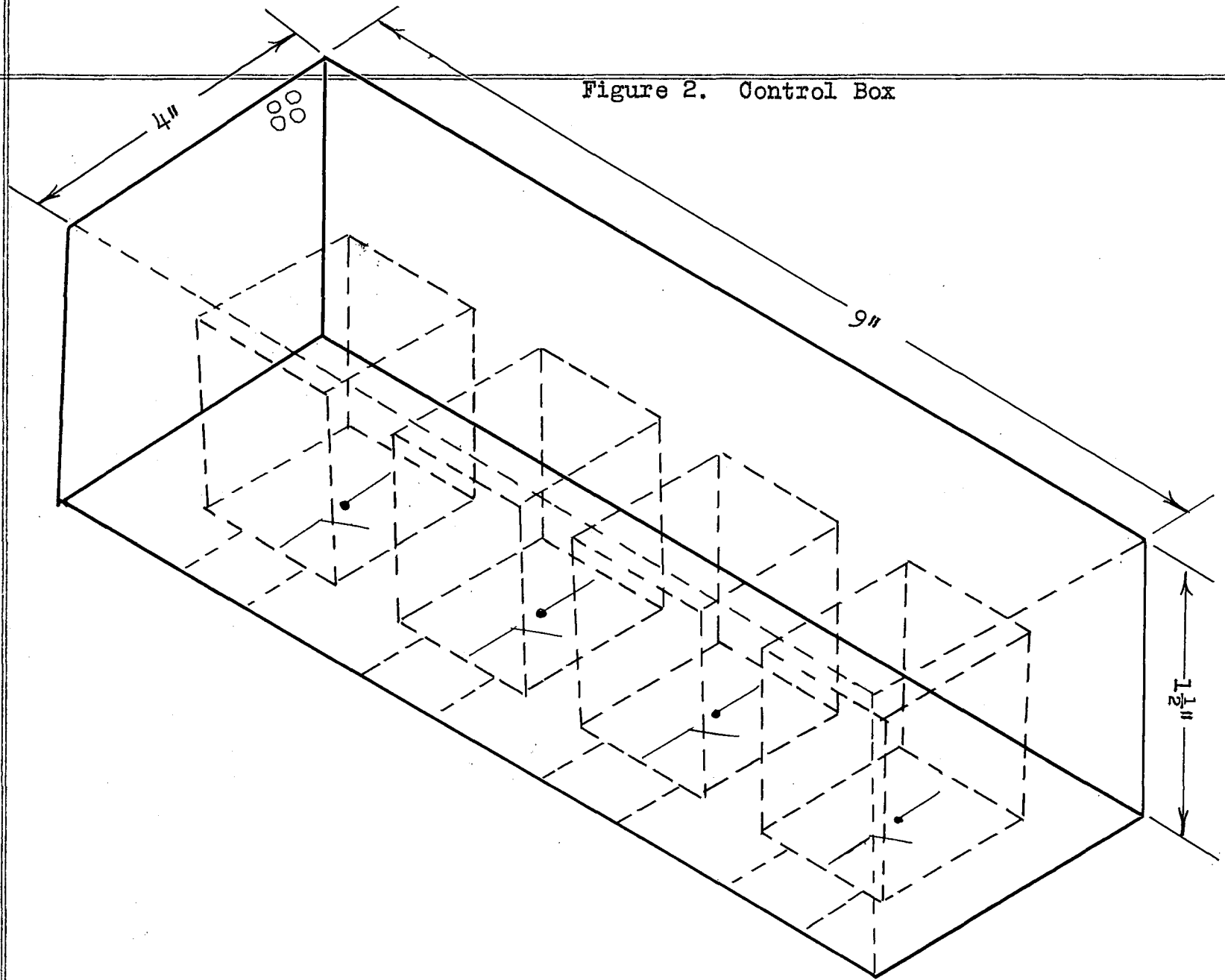


Figure 3. Inclined Plane Switch

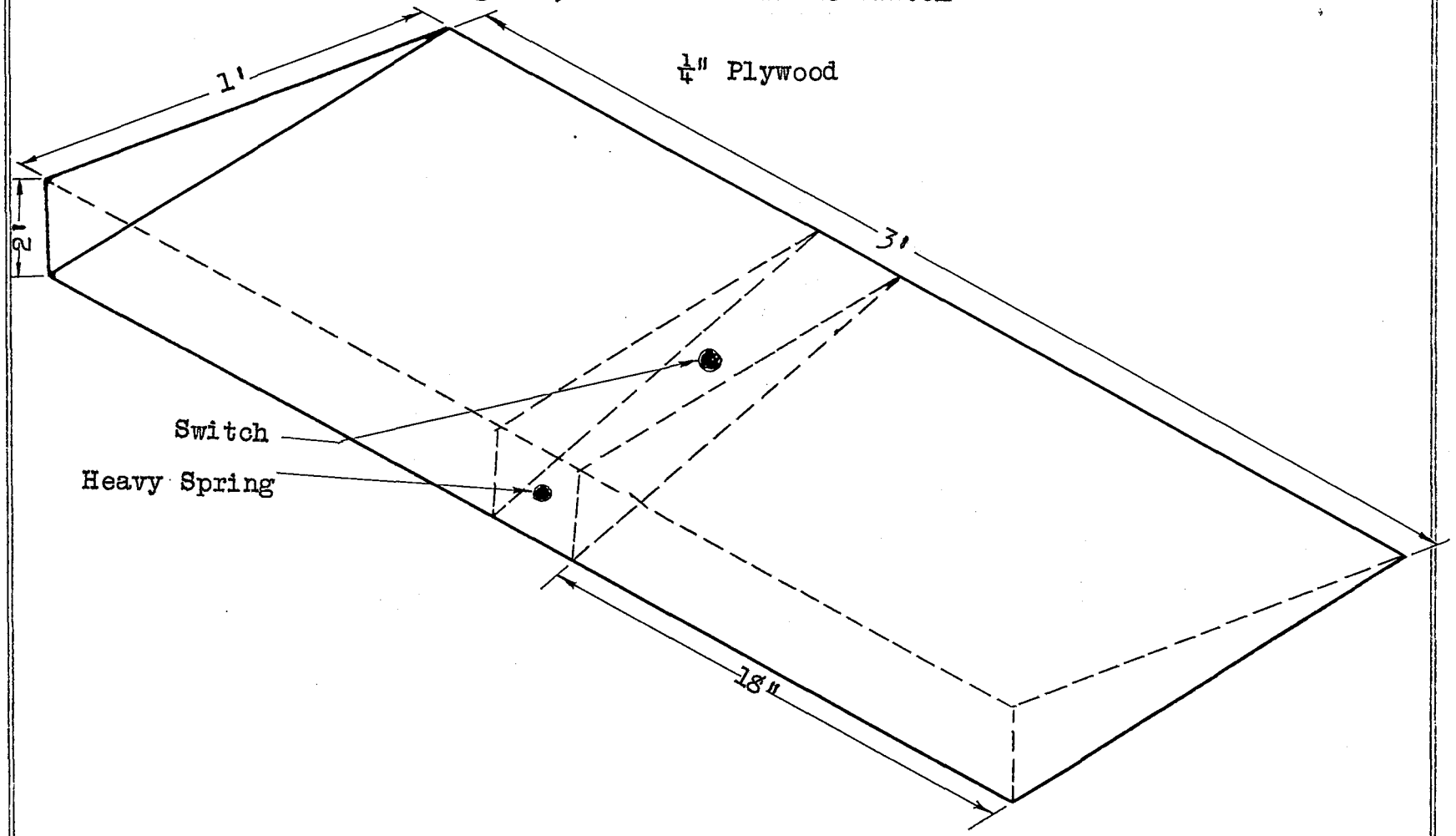
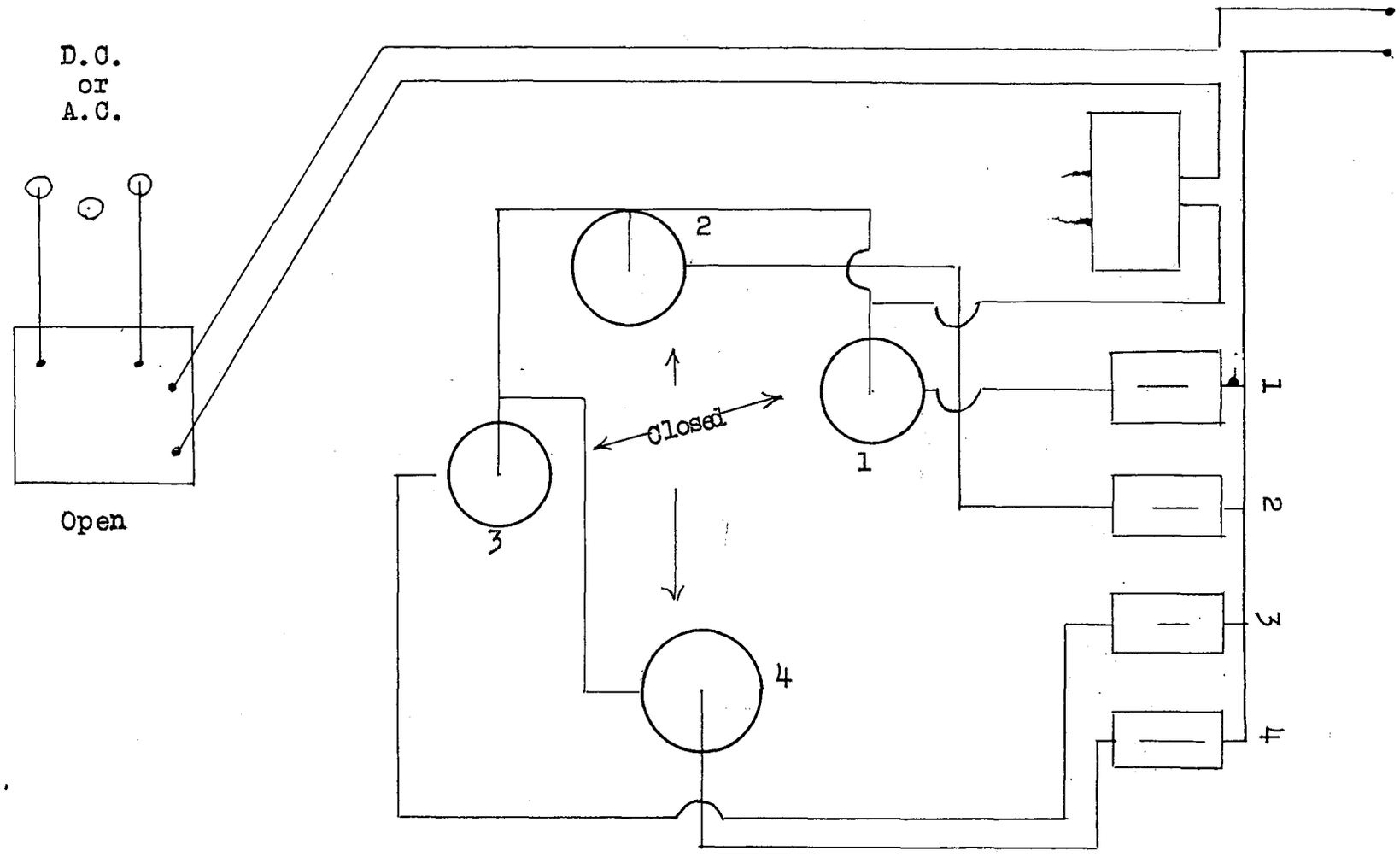


Figure 4. Wiring Diagram



Method and Procedure.— Each candidate was given the following instructions:

> You are going to have a reaction test. Assume you are playing middle backerup. The first time you will be given one practice play, then four plays. Keep your eyes on the screen and try to diagnose the play as quickly as possible. Around you you see four inclined plane switches, the one in front of you represents a buck up the middle, the switches on either side of you represent end sweeps, and the one in back of you represents a forward pass. Take a good stance and be ready to react as quickly as you can. If you make a mistake recover quickly and step on the correct incline plane.

The time which elapses between the stimulus and response is read in hundredths of a second directly from the clock.

Large muscle reaction time is tested by having the subject face the screen. The moment he receives the stimulus the movement required is a leap or long stride to bring the foot within striking distance of the inclined plane switch.

The justification for the use of this method is that it tests the very type movement essential for good backerups.

CHAPTER V

PRESENTATION AND ANALYSIS OF DATA

Presentation of data.— The purpose of the study was to determine whether a reaction time test of large muscle groups would aid in the selection of material. It is also an investigation to find the relationship, if any, between the sport skill of backing up a line and reaction time.

Statistical techniques.— The procedure followed was to test thirty candidates on four different occasions, given a total of sixteen responses. The test consisted of four series of four responses each. This data is presented in table form on pages thirty two to thirty nine.

From these tables the mean was found for each of the thirty candidates in Series I, II, III, IV; the mean of the entire four series, also the mean for the bucks, end sweeps to the right, end sweeps to the left and forward pass. This data is presented in table form on pages twenty to twenty three.

The standard deviation was then found for the following:

1. Mean scores of the entire four series
2. Mean scores for the buck or dive
3. Mean scores for the end sweep right
4. Mean scores for the end sweep left
5. Mean scores for the forward pass

The formula used for finding the standard deviation was determined by Garrett's[1] formula.

$$S.\ D. = \sqrt{\frac{E(fd^2)}{N}}$$

This data is presented in table form on page twenty three.

1/ H. Garrett, Statistics in Psychology and Education, Longmans, Green and Company, New York, 1955, p. 46.

2/ E. F. Lindquist, A First Course in Statistics, Houghton Mifflin Co., Boston, 1942.

Table 1. The Means of the Four Series of Reaction Time Test for Thirty High School Varsity Football Players

hundredths/seconds

Case Number	Series I Mean	Series II Mean	Series III Mean	Series IV Mean	Total Mean
(1)	(2)	(3)	(4)	(5)	(6)
1	1.86	3.35	3.58	5.34	3.53
2	2.74	2.96	4.77	4.31	3.67
3	1.45	1.91	3.14	4.10	2.65
4	4.89	3.74	4.59	5.11	4.58
5	2.40	3.08	5.11	2.96	3.39
6	2.45	2.27	3.89	4.29	3.23
7	2.05	2.28	4.00	3.63	2.99
8	2.24	2.07	2.71	4.68	2.93
9	2.89	2.89	4.34	4.47	3.65
10	2.38	2.91	5.82	4.91	4.01
11	2.31	2.09	4.21	4.41	3.26
12	2.83	3.22	4.39	4.66	3.78
13	2.49	3.97	4.72	4.22	3.85
14	2.72	3.19	4.73	4.08	3.71
15	3.30	2.59	5.78	4.85	4.13
16	1.93	4.62	4.51	4.96	4.01
17	2.18	3.00	4.40	5.08	3.67
18	2.62	4.00	4.60	4.54	3.94

(concluded on next page)

Table 1. (concluded)

Case Number	Series I Mean	Series II Mean	Series III Mean	Series IV Mean	Total Mean
(1)	(2)	(3)	(4)	(5)	(6)
19	3.04	3.59	3.54	3.50	3.42
20	3.05	4.16	3.54	5.19	3.99
21	2.10	2.39	4.04	4.97	3.38
22	2.62	3.71	3.95	5.61	3.97
23	2.36	2.24	5.21	4.51	3.71
24	3.90	5.32	4.10	5.37	4.67
25	2.46	5.04	5.57	3.70	4.19
26	3.33	2.11	3.32	4.13	3.22
27	2.85	2.97	3.77	4.42	3.50
28	2.52	2.47	4.93	4.64	3.64
29	2.70	2.79	5.01	6.31	4.20
30	3.05	2.89	3.65	3.93	3.38

Table 2. The Means of the Four Categories (Buck, Right, Left, Pass) for Thirty High School Varsity Football Players

Case Number	Buck or Dive	End Sweep Right	End Sweep Left	Forward Pass
(1)	(2)	(3)	(4)	(5)
1	5.64	3.12	2.54	4.58
2	4.20	4.15	2.91	3.50
3	3.79	2.69	2.45	2.52
4	5.16	4.72	4.14	4.55
5	3.12	4.05	4.12	4.76
6	3.54	4.17	2.31	2.89
7	2.99	2.94	3.55	4.99
8	3.75	2.93	1.88	3.14
9	4.00	4.64	2.39	2.99
10	4.53	4.19	2.95	2.52
11	3.42	3.89	2.81	2.89
12	4.73	3.36	2.78	4.21
13	5.07	4.21	2.62	4.62
14	3.36	4.40	2.96	3.96
15	4.83	4.37	3.01	4.19
16	3.66	6.51	2.71	3.16
17	3.42	3.21	3.66	4.39
18	4.86	3.96	3.11	3.82
19	3.83	3.74	2.29	3.96

(concluded on next page)

Table 2. (concluded)

Case Number	Buck or Dive	End Sweep Right	End Sweep Left	Forward Pass
(1)	(2)	(3)	(4)	(5)
20	4.28	3.81	3.95	4.91
21	4.65	4.14	3.66	3.12
22	4.09	3.83	4.35	4.83
23	4.21	4.17	2.72	3.35
24	4.15	3.66	3.81	5.61
25	5.06	4.33	3.42	2.98
26	3.91	3.59	2.60	3.21
27	3.68	3.62	3.68	3.05
28	3.65	4.39	3.66	3.95
29	4.13	4.49	2.86	3.49
30	4.03	3.16	2.54	3.53

Table 3. The Means and Standard Deviations of the Five Important Categories in the Reaction Time Test

Reaction Test	Mean	Standard Deviation
(1)	(2)	(3)
Four Series	3.67	.454
Buck or Dive	4.12	.630
End Sweep Right	3.95	.711
End Sweep Left	3.08	.673
Forward Pass	3.61	1.01

Analysis of data.— From an analysis of the data of Tables 1. and 2. on pages twenty to twenty three the following charts offer aid in inspecting the results:

Table 4. Top Ten Backerup Candidates from Mean Scores of the Four Series: Buck, Right Sweep, Left Sweep, Forward Pass

Case Number	Four Series	Buck	Right Sweep	Left Sweep	Forward Pass
(1)	(2)	(3)	(4)	(5)	(6)
1	3	7	3	8	3
2	8	5	8	19	10
3	7	14	7	6	6
4	26	11	1	9	11
5	6	17	30	3	25
6	11	6	17	1	9
7	30	28	12	30	27
8	21	16	26	26	21
9	5	27	27	13	8
10	19	8	24	16	16

Below is the number of times each candidate appeared in the top ten in the five important categories.

Candidate	Number of Appearances
1	2
2	0
3	4
4	0
5	2
6	4
7	3
8	5
9	2
10	1
11	3
12	5
13	1
14	1
15	0
16	3
17	2
18	0
19	2
20	0
21	2
22	0
23	0
24	1
25	1
26	3
27	3
28	1
29	0
30	3

The six seniors (case numbers 7, 8, 26, 27, 28 and 30) used for measuring stick purposes did very well.

Case Number 8 was the captain of the 1953 undefeated Newton High School football team and middle backerup in the basic 5-3-2-1 and 6-3-2 defenses. He perhaps was the best backerup in Newton High School history. He had speed, but was not outstandingly fast, so speed alone could not account for

his fine scores. It should be noted that he was a middle backerup and through ability and experience he scored very well in movements right and left in stopping and sweeps.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Summary.— This was undertaken to discover what relationship existed between a person's football backerup ability and his bodily reaction time.

To carry out this test, an instrument had to be developed to accurately record the reaction time of the large muscle groups.

The coaches at Newton High School, after studying the results of the test, did the following:

Case Number 3.— This boy was a junior with very little defensive experience. He played some as an offensive halfback. His future in football was one of questionable status. His fine test score prompted the coaches to give him a chance at the backerup position which he played in his senior year with remarkable success. If the test had not been conducted this boy would not have been considered immediately for the position.

Case Number 6.— This boy was a right linebacker for the junior varsity football squad with a fair recommendation. His main weakness was slowness. The test results pointed out the fact that he was far better going to his left than right, therefore he was used as a left linebacker

in his senior year with satisfactory results. This boy was right-handed so left handedness could not account for his better score going to the left.

Case Number 26.— This boy was an outstanding offensive end on the undefeated football team. Because of his quick reflexes he was moved into a defensive halfback position and did an outstanding job. At the conclusion of the season, in the reaction time test, this boy did well in the overall scoring, further exemplifying the importance of quick reaction time.

Case Number 7.— This boy was a senior who had not played football since junior high school. He played defensive safety man the entire season. He was only moderately fast and was a doubtful prospect, but once given the opportunity, he performed well and remained at the safety position. His test results brought out the fact that although he was not too fast, his quick reaction enabled him to make up for his lack of speed.

Conclusions.— The writer feels that quick reaction time to an external stimulus is a good indication of ability in the backerup position. As previously stated, other factors as well as reaction time have to be considered such as courage, desire, emotional and mental stability.

From the findings of this study, it would appear that the following implications can be assumed:

1. Candidates with the best reaction time were not only the best football players, but were better in other sports where quick reaction time is a factor. Of the top ten in the test, eight played other sports as well as football.
2. Experience and maturity have a direct effect on reaction time.
3. The testing of reaction time of large muscle groups is a definite aid to the coach in selecting his backerups and halfbacks and also safety man.

Whether he is big or small, the boy who is able to react to situations quickly has won many athletic contests with this quick response ability.

Limitations.-- The equipment had to be moved several times because of its use in various classrooms. This made a difficult and delicate handling job because of all the intricate wiring and the different pieces of equipment.

The reaction time clock was a very delicate thing and needed careful handling.

The incline plane switches wear out from the continuous pounding they receive.

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APPENDIX

Table 5. Scores in the Reaction Time Test for Thirty High School Varsity Football Players

Series I

Reaction Time hundredths/seconds

Case Number	I	II	III	IV
(1)	(2)	(3)	(4)	(5)
1	.87	1.50	3.20	1.86
2	2.76	3.50	2.39	2.29
3	2.55	1.02	2.34	1.87
4	4.67	3.44	6.40	5.07
5	1.15	1.66	4.17	2.63
6	1.67	5.50	1.60	1.05
7	1.25	1.40	4.53	3.95
8	4.67	2.01	1.03	1.26
9	4.00	3.46	2.16	1.96
10	2.05	2.77	2.55	2.14
11	3.12	1.84	2.51	1.77
12	4.20	2.00	2.83	2.29
13	2.24	3.10	2.58	2.03
14	2.43	3.52	2.38	2.54
15	4.67	2.80	2.77	2.99
16	2.95	2.48	1.68	.60
17	2.44	1.40	2.58	2.33
18	2.20	2.35	3.21	2.71

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Table 5. (concluded)

Case Number	I	II	III	IV
(1)	(2)	(3)	(4)	(5)
19	3.27	3.82	1.38	3.66
20	3.58	3.10	2.57	2.95
21	2.50	1.88	2.35	1.70
22	2.35	2.68	2.86	2.62
23	2.25	2.28	2.53	2.39
24	3.25	2.53	4.31	5.54
25	2.40	3.05	2.46	1.93
26	4.67	2.20	2.32	4.15
27	2.90	3.02	2.56	2.94
28	2.08	2.90	2.55	2.53
29	2.55	2.61	2.92	2.77
30	3.71	3.66	2.32	2.50

Type of Play and Duration of Time

I	Buck	4.67
II	Sweep Right	7.64
III	Sweep Left	10.84
IV	Pass	11.50

Table 6. Scores in the Reaction Time Test for Thirty High School Varsity Football Players

Series II

Reaction Time - hundredths/seconds

Case Number	I	II	III	IV
(1)	(2)	(3)	(4)	(5)
1	1.80	7.70	1.53	3.70
2	1.54	4.22	2.63	3.43
3	1.90	1.55	1.34	2.87
4	2.50	5.95	3.57	2.95
5	1.85	2.00	3.90	4.51
6	2.30	1.25	2.25	3.27
7	2.80	1.46	1.62	3.27
8	1.83	1.08	2.36	3.01
9	2.11	2.62	2.72	1.88
10	2.37	3.54	2.56	3.16
11	1.88	2.15	1.58	2.76
12	1.86	4.70	2.48	3.83
13	2.30	7.30	3.20	3.08
14	2.77	4.12	2.68	3.12
15	1.90	2.46	2.42	3.53
16	2.28	3.11	10.56	2.55
17	3.40	2.60	2.80	3.20
18	2.18	6.94	3.75	3.14

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Table 6. (concluded)

Case Number	I	II	III	IV
(1)	(2)	(3)	(4)	(5)
19	2.31	6.10	2.29	3.33
20	2.39	4.76	3.00	6.51
21	1.72	2.74	2.09	3.04
22	5.73	3.92	2.53	2.99
23	1.58	1.70	2.08	3.61
24	2.70	7.70	3.56	9.35
25	3.58	7.70	5.35	3.55
26	1.65	2.30	1,95	2.55
27	2.60	2.47	3.26	3.58
28	1.27	2.51	2.85	3.30
29	1.65	3.33	2.78	3.43
30	1.93	3.34	2.48	2.82

Type of Play and Duration of Time

I	Sweep Left	12.42
II	Buck	7.70
III	Sweep Right	10.56
IV	Pass	8.13

Table 7. Scores in the Reaction Time Test for Thirty High School Varsity Football Players

Series III

Reaction Time hundredths/seconds

Case Number	I	II	III	IV
(1)	(2)	(3)	(4)	(5)
1	2.92	5.25	3.35	2.78
2	6.42	4.26	4.40	4.00
3	2.55	1.83	2.58	5.61
4	6.40	3.27	4.04	4.56
5	4.77	3.85	7.89	3.95
6	4.61	2.13	3.00	5.81
7	4.66	5.97	3.95	4.49
8	2.30	3.43	1.30	3.80
9	7.44	3.03	2.95	3.95
10	7.02	4.00	3.72	8.54
11	6.95	2.02	3.75	4.10
12	3.05	5.34	3.57	5.60
13	6.00	4.02	3.55	5.30
14	6.68	4.47	3.94	3.78
15	6.25	4.54	5.15	7,20
16	7.44	3.30	4.17	3.15
17	3.26	5.42	5.74	3.20
18	4.35	4.27	4.46	5.30

(concluded on next page)

Table 7. (concluded

Case Number	I	II	III	IV
(1)	(2)	(3)	(4)	(5)
19	4.62	3.12	2.79	4.60
20	3.37	3.86	3.60	3.32
21	7.44	2.00	3.44	3.28
22	4.63	3.17	3.97	4.05
23	7.44	2.16	4.30	6.99
24	3.80	3.55	4.88	4.22
25	7.44	4.57	5.60	4.70
26	3.08	3.32	3.65	3.25
27	3.50	2.78	4.91	3.90
28	7.44	3.65	3.19	5.43
29	7.44	3.54	3.86	5.20
30	2.22	4.53	3.29	4.58

Type of Play and Duration of Time

I	Sweep Right	7.44
II	Pass	8.82
III	Sweep Left	11.80
IV	Buck	8.54

Table 8. Scores of the Reaction Time Test for Thirty High School Varsity Football Players

Series IV

Reaction Time hundredths/seconds

Case Number	I	II	III	IV
(1)	(2)	(3)	(4)	(5)
1	1.90	7.52	6.55	5.39
2	3.30	4.03	4.06	5.44
3	2.80	3.50	5.85	5.44
4	3.60	6.89	5.45	5.44
5	2.57	8.03	5.88	5.38
6	2.35	5.09	4.30	5.44
7	2.93	6.77	4.08	4.75
8	3.37	4.87	5.05	5.44
9	2.37	5.12	4.96	5.44
10	3.17	7.77	4.60	4.10
11	3.09	5.00	5.22	4.32
12	2.84	5.40	5.91	4.48
13	2.05	9.35	5.05	5.44
14	2.76	5.73	4.73	3.10
15	2.20	6.20	6.03	5.00
16	2.68	6.17	5.55	5.44
17	2.91	6.62	5.38	5.44
18	2.60	5.15	5.40	4.99

(concluded on next page)

Table 8. (concluded)

Case Number	I	II	III	IV
(1)	(2)	(3)	(4)	(5)
19	2.70	5.72	4.25	1.35
20	3.25	6.32	5.75	5.44
21	3.10	5.72	4.25	5.91
22	4.85	6.65	5.49	5.44
23	2.49	5.25	4.87	5.44
24	3.35	5.97	4.74	5.44
25	2.02	1.87	5.50	5.44
26	2.50	2.80	5.80	5.44
27	4.65	2.90	4.70	5.44
28	3.31	6.23	4.40	4.60
29	2.99	11.69	5.14	5.44
30	2.62	4.25	4.30	4.47

Type of Play and Duration of Time

I	Sweep Left	7.04
II	Pass	11.69
III	Sweep Right	9.62
IV	Buck	5.44