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MOVEMENT RESPONSE TIMES ASSOCIATED WITH BLOCKING IN FOOTBALL
FROM THE THREE- AND FOUR-POINT CENTER STANCES

A Thesis
Presented to
the Graduate Faculty
Central Washington State College

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

by
Robert Louis Ames

July, 1969

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CHAPTER I

INTRODUCTION

The game of football has been continually changing since its beginning in 1873. One of the first major changes was limiting the number of players on a team to eleven and further limiting these players to seven linemen and four backs. These eleven positions were given names at that time and they are still in use in the modern game.

At first an attempt was made to do away with the mad confusion that occurred when starting the game. Consequently, the ball was put into play by the center, who touched it with his foot, then handed it to the quarterback, who had to pass or hand the ball to another back before moving forward himself.

In 1882 Walter Camp invented a yards and downs system. A team had to gain 5 yards or lose 10, in three plays from scrimmage or give the ball to the opposing team. In order to tell if a team gained 5 yards or lost 10, a field was marked in five-yard squares. The scoring system has been revised many times but the basic idea has remained.

To maintain possession of the ball, teams began to send runners in front of the ball carriers as interference. This soon developed the "V" formation, where every player

formed a large, loosely fit "V" with the ball carrier inside of its apex.

Newer faster mass movement formations were invented and the game became more brutal and bloody each year; then in 1906, the National Collegiate Athletic Association was organized, and its first act was to outlaw interlocking interference and ban the "V" formation. It also established a neutral zone between the scrimmage lines, and legalized the forward pass (23:12).

In the early stages of football, players used the two-point stance, but with the elimination of the "V" and limiting the players to seven linemen, the three- and four-point stances came into use for the purpose of enabling the players to assume a position which would permit faster movement.

Soon new formations were developed. There was the "Single Wing" which was characteristic of the early type of football, based on mass formation for power. Coaches using the "Single Wing" soon turned to the "T" formation, which began to open the game with more deception than power. Not long after the "T" formation was installed, the "Split T" came into existence with deception and speed.

Today football is much more scientific, and more complex than at any other time. It has become a game of

speed, deception, and power combined with a high degree of skill.

The "T" formation in football has changed the center position from a part time blocker to a full time blocker. In the "Single Wing" offense the center's head was down between his legs in order for him to snap the football back to his backfield men four or five yards deep. In this stance the only thing he could do after he snapped the football was to protect himself. The invention of the "T" formation with the quarterback directly behind the center, the automatic exchange between them made it possible for the center to keep his head up at all times and concentrate on the person he is assigned to block. George Halas states:

A center is badly handicapped as a blocker. He is known as "half a man" in the department. This does not hold true in the "T" offense as he can take a stance that enables him to charge as he passes the ball. He is not required to look at the receiver but can keep his head up and see what is going on (15:11).

One of the disturbing things found in football coaching is the blocking by the center. It has never been clear whether the three-point stance or the four-point stance provides the most effective method of blocking.

Many articles have been written by coaches about the two types of center stance and their different foot variations, but no one has stated which stance contributes to the best movement for blocking proficiency.

I. THE PROBLEM

Statement of the Problem

The purposes of this study were: (1) to determine the significance in variability between right, left, forward and backward movement times resulting from assuming the three-point and the four-point center stances, for junior high, senior high, junior college and college football players without previous experience at the center position; and (2) to determine the significance of difference between means of right, left, forward and backward movement of the three-point and four-point stances for each of the groups, viz., junior high, senior high, junior college and college.

Importance of the Study

Football coaches are continually looking for ways of improving their teams offensive proficiency. This could include a great number of maneuvers, but one of the important factors that should receive consideration is the stance of the offensive center. Speed is vital to good offensive football and a great number of starting positions have been developed in an attempt to gain quick and fast total body movement; however, there has been very little objective evidence as to which stance will give maximum speed of movement. This study may provide football coaches with the much needed evidence which could be used by them in

determining which stance their offensive center should use to obtain the fastest speed of movement in blocking right, left, forward and backward.

Limitations of the Study

The study was limited to forty-eight male students: twelve from East Junior High in Puyallup, Washington; twelve from South Kitsap High School in Port Orchard, Washington; twelve from Olympic Community College in Bremerton, Washington; and twelve from the University of Puget Sound in Tacoma, Washington. Each subject had football experience, but not at the center position. The subjects were between fourteen and twenty-three years of age and all were right hand dominant.

II. DEFINITIONS OF TERMS USED

Movement time. The amount of time elapsing between initiation of movement and the completion of that movement.

Stance. The preparatory body position taken by the offensive center immediately prior to charging. The number preceding the word "stance" indicates the number of the supporting points in contact with the ground; e.g., both feet and one hand on the ground is a three-point stance.

III. SCOPE OF THE STUDY

The remainder of the paper is divided into four chapters. Chapter II is a review of the literature dealing predominantly with the two types of center stance. Chapter III consists of methods and procedures used in conducting the study. Chapter IV is a report of the results of this study. The final chapter consists of conclusions drawn from the study.

CHAPTER II

REVIEW OF THE LITERATURE

Even though the stance is relatively important to good offensive football very little research has been done to determine which of the stances provides the best blocking right, left, forward, and backward for movement time. Many studies dealing with reaction time to light or vocal starting stimulus have been conducted but relatively few studies have been completed on the movement time for a particular stance. Many of the articles and books written by coaches express a preference for a particular stance but they indicate no conclusive evidence that the stance preferred is the best to provide blocking proficiency right, left, forward and backward for movement time.

I. MOVEMENT TIME

Elbel (10:295) studied the speed and horizontal force in blocking with forty-five University of Kansas football players in complete football uniforms. No special stance or body position was prescribed. The signal to block was given by a voice amplifier synchronized with a clock which was stopped the instant the shoulder struck a padded dummy, placed at thirty-six inches from the shoulder when in the

starting position. The results showed no relationship between the speed of charge and the force exerted.

Manolis (22:170) studied the response times of thirty-one subjects who were members of the University of California football team. Each subject was given twenty trials and was permitted to use any stance and body position desired. A trial consisted of a start in response to a varied signal followed by a forward lunge. A hinged plate was placed twelve inches from the front of the subject's head so that as the subject lunged forward he would strike the plate with his head. The starting signal started the timer and as contact with the striking of the plate was made, the timer was stopped and the time recorded. No significant difference was found between response time and position played.

Another study involving reaction time of eighty-seven football players from a normal offensive stance was made by Miles (24:5) who found that the fastest response time for the groups tested occurred in the following order: backs, ends, guards, tackles, and centers. Significance of difference between groups was not presented.

In an attempt to determine the effect of front-to-rear and lateral variation in foot spacing and variations in hand-to-toe anterior posterior spacing and movement, Owens (28:66) used a specially constructed apparatus to

measure the speed of movement of twenty varsity football players. The timing device measured the movement time from the instant a vocal stimulus passed through a sound amplifier until the movement of a lever resting against the forward edge of the subject's shoulder caused the clock to stop as he charged. Each subject was given a stance board which had the position of the feet and hands marked on it. This was done to control the hand and feet positions. All subjects ran from each stance four times. Analysis of the data showed a one per cent level of significance for the differences between the various movement times measured. It was also found that the length of the legs did not affect hand and foot spacing when speed of movement was the determining criterion.

The literature reveals many differences of opinions as to the best stance, type of foot variation, and the ability to block effectively in all directions after the exchange of the ball. Much of the source material is only the philosophy of various individuals.

II. TYPES OF CENTER STANCE

In the "T" formation there are two types of acceptable stances, the four-point and the three-point. The type used depends on the philosophy of the individual coach. Descriptions used herein apply to right-handed players.

Four-point Stance

The fundamental techniques for the four-point stance include the following:

The feet are approximately shoulder width apart, with the heels about two inches off the ground. The ankles and knees are flexed and pointed straight ahead. The tail is slightly higher than the shoulders, causing the torso to be extended forward, which shifts the center of gravity forward, thereby placing the weight on the ball through the center's hands. The head is up and eyes looking down-field. The center may either extend both arms to the ball with the right hand on the top right side of the ball and the left hand on the lower left side of the ball, or place the left hand directly down to the ground and extend his right hand to the ball, keeping his arm straight.

Bud Wilkinson, one of the nation's former top football coaches, commented:

Unlike most T-formation centers our Oklahoma pivot-men are taught to place considerable weight on the ball. This means that our center has almost half his weight on the ball as he takes his stance. This will force him to take a step forward as he moves the ball (34:42).

The basic idea behind the four-point stance is to have the center always move forward. This will enable the quarterback to have working room behind the center. Homer Rice, an advocate of the four-point stance, said:

The center's feet are no more than toe to instep alignment. With the heels off the ground his weight is

directly on the ball through his hands, because of his weight on the ball, he always moves forward (29:55).

Three-point Stance

The fundamental techniques for the three-point stance include the following:

The feet are moderately spread, as wide apart as your ability to move in any direction will permit without lowering the tail. The feet are parallel with the toes and heels even, or slightly staggered. Both heels are slightly off the ground, and the weight is on the balls of the feet. The ankles and knees are flexed and pointing straight ahead, and in line with the feet. The tail and hips are slightly higher than the shoulders, and are square to the line of scrimmage with the shoulders. The torso is in a parallel plane with the ground, and the back is arched slightly. The head is tilted back and the eyes are looking directly down the field. The right arm is straight to the football, with the right hand on the forward right side. The left arm is fairly straight to the ball, with the left hand on the lower left side. The weight is evenly distributed on the balls of the feet, with little or no weight on the ball.

George Halas, former coach of the Chicago Bears, comments, "The center should be well over the ball, and there should be no weight on the ball" (15:11). The three-point stance is designed to give the center more freedom to

move and block in all directions. Dan Devine of Missouri agrees with Halas' theory on the three-point stance and says, "The center uses both hands to grip the ball, and very little weight is on the ball" (3:42).

The three-point stance is used by all centers in the punting game of football. Donald Fuoss states:

Most coaches favor a toe-to-instep staggered stance, with the feet wider apart, little weight forward on the football, most of the weight is on the balls of the feet, eyes on the target (the inside thigh of the punter's kicking leg) for their center (12:101).

III. FOOT VARIATION IN THE STANCE

There are three types of foot variation used in the center's stance: the square variation with the toes and heels even in a boxed stance, the slightly staggered variation with the right foot toe to instep of the left foot, and the staggered variation with the right foot in advance of the left. The last variation should be used only by right-handed centers.

Many coaches use different foot variations for the center. Possibly this is from the philosophy of the offense used, or it could be from the size and ability of the individual playing center.

George Allen, head football coach of the Los Angeles Rams points out:

The center must assume his position so that it will be comfortable, solid and afford him freedom of movement

of the arms when passing the ball between his legs. There are three types used today, (a) with the feet even, (b) with the left foot forward, (c) with right foot in advance of the left provided the center is right handed. We definitely favor the latter one (1:287).

Giese and Tatum, talking about the three-point stance with the feet even, commented:

The center's feet should be placed approximately shoulders width, with the weight on the balls of the feet. The feet are parallel to the line of scrimmage. This square stance allows the center to step with either foot and won't box in the quarterback preventing him from stepping up into the line where he must operate (14:209).

IV. PERFORMANCE OF BLOCKING ABILITY

With the two types of stance and variations in each stance, blocking of the center is important regardless of whether it is for the automatic exchange with the quarterback, pass protection block or the block after the long snap back on punt formation. Gomer Jones, former football coach at Oklahoma states, "No center will ever exchange the ball unless he moves out in a good blocking form, stepping with the proper foot and maintaining a good football position" (18:42).

The performance of blocking by the center is complicated by the primary duty of snapping the football. Don Fuoss comments:

Regardless of the offensive system employed, the center's principal responsibility is to snap the ball safely to one of his backfield men. His secondary responsibility is to block (12:89).

Once the exchange of the ball becomes automatic, then the center can be counted on as an added blocker. Giese and Tatum comment:

The "blind" center-quarterback exchange is quickly accomplished and permits the center to start in and maintain a good football position. This allows the planning of offensive plays using the center as a full-fledged blocker and a coach may expect the same type of blocking job from him as any other lineman might perform (14:210).

The blocking of the center can be broken down into four main areas of movement: straight ahead, left, right, and backward. Each area requires a different kind of movement to execute a block properly. The straight ahead block is a shoulder block used when the man is playing directly over the center or off the line of scrimmage. The blocks used to the left and right are the cut-off block, scramble block, or reverse cross body block. These blocks are used because the defensive man has the advantage on the center. The block used in movement backward is the position block. This block is merely used to stop penetration on passing and punting situations.

One distinct advantage the center has over his opponent is that he knows exactly when he is going to snap the ball. This advantage, plus the addition of the T-formation where the center's head is up so he can concentrate on the opponent who is going to be blocked, greatly aids in the blocking performance of the center.

As stated earlier, it appears that current practice in blocking by the center depends mostly on the point of view of the coach rather than upon objective evidence related to measured performance.

CHAPTER III

METHODS AND PROCEDURES

The purpose of this study was to investigate the right, left, forward, and backward movement times resulting from the three- and four-point center stances. The stances tested were selected from those most commonly used by offensive centers. Subjects without previous experience at the center position were used exclusively, as explained below.

I. SUBJECTS

The subjects for the experiment were selected from the football teams of East Junior High, South Kitsap High School, Olympic Community College, and the University of Puget Sound. Each subject had football experience, but not at the center position. It was felt that an experienced center would doubtless display ability in movement time from his accustomed stance to a greater degree than from an unaccustomed stance which would, in turn, bias the test results unduly. Each subject was judged to be in good physical condition, and a variety of physiques were represented.

II. TEST PROCEDURE

Each subject reported for the experiment in a regulation gym suit and tennis shoes. All tests were conducted

on the gym floor. Instructions were given which explained the starting signal, the distance to be covered in executing the block, and the number of repetitions from each stance. A detailed description and demonstration of the stance and blocks was given to each group. As one stance was completed, the next stance was explained and demonstrated. This procedure was followed for each group.

Instructions for Subjects

The subject was first shown the three-point stance with each foot variation. He was allowed to use any or all of the foot variations he chose. He assumed the stance and gripped the ball with his right hand and used his left hand to guide the ball. The subject was then instructed in the blocking movement, with the dummy placed three feet away from him at all times, in all four areas of movement.

The block used in all four areas of movement was the head and shoulder block. The subjects were instructed to step with either foot first and make contact with head and shoulder at the target, simulating a block at the chest or mid-section. The movements forward, right and left are one step movements, while the block backward is a two step movement. The subject, after exchanging the ball, took two steps backward and then moved forward to make contact with the target on the dummy. The backward block is a pass

protection block, so the center must be able to set-up and make contact with the target as soon as possible.

After the blocks were demonstrated in all four areas of movement, the same procedure was followed for the four-point stance.

Randomizing Effects of Learning

There were twelve subjects in each of the four groups, junior high, senior high, junior college and college, for a total of forty-eight subjects. In order to randomize the practice effects, each group was subdivided into four groups of three subjects each. Group "A" started with the block to the right first, then left, forward and backward. Group "B" started with the block to the left first, then forward, backward, and right. Group "C" started with the forward block first, then backward, right and left. Group "D" began with the block backward first, then right, left, and forward. In this way each group started with a different stance and blocking movement, causing the effects of learning to be randomized rather than summated in a particular sequence. Figure 1 illustrates this concept.

Group	Blocks			
	Right	Left	Forward	Backward
A	Start 1	2	3	4
B	4	Start 1	2	3
C	3	4	Start 1	2
D	2	3	4	Start 1

FIGURE I
SEQUENCE OF BLOCKING DIRECTION

A coin tossed in the air coming up heads determined that the three-point stance was used by the junior high subjects first, senior high last, junior college first and college last.

Timing of the Subjects

The ball was consistently placed three feet from the dummy, by using a piece of heavy cloth three feet long attached to the bottom of the dummy. The subject then took his position over the ball. When the subject was ready, a switch controlling the clock and the buzzer was opened and the subject moved to make contact with the target on the dummy. The circuit was closed and the clock stopped when the subject made contact with the one foot square target

attached to the blocking dummy. The subject was instructed to perform each blocking movement five times from each stance. To constitute a fair trial each subject made contact with the hands of the person receiving the ball, simulating the quarterback. Failure to do this caused the trial to be repeated.

The Stances

The stances were assumed by each subject as previously described. Each stance is illustrated in Appendix A.

Head and Shoulder Block

The blocker drove his head and shoulder directly into the blocking dummy at the chest or waist area. He was allowed to step with either foot first.

Timing Device

The timing of the center snap was accomplished with a millisecond clock, constructed by the Standard Electric Time Company of Springfield, Massachusetts. Type--MST 500; Motor--115 volts; Speed--two revolutions per second; 60 amperes and 60 cycle. The clock was activated by a 6-volt electrical circuit. The control panel had a 110-volt circuit attached directly to the switch and buzzer which was reduced to a 6-volt circuit for the clock and the shut-off

switch. With the 110-120-volt circuit the control panel can be plugged into any 110-120-volt wall outlet. The buzzer used for the starting stimulus was a 110-volt Simplex door-bell buzzer.

When the switch on the control panel was opened, the clock and buzzer started automatically. When the subject hit the sensitive shut-off switch attached to the dummy, the clock stopped. The clock measured the elapsed time in thousandths of a second. The control panel, millisecond clock, and buzzer are pictured in Appendix A.

III. DATA ANALYSIS

Hartley's F-Maximum Test

Bruning and Kintz (5) presented a test for difference among several independent variances called the Hartley F-maximum test for homogeneity of variances. They cited a Master's thesis by Winkler at Ohio University in 1967, who empirically tested the power of several tests of homogeneity of variance. Among five tests examined, Winkler concluded that Bartlett's test and the F-maximum test (F max) are preferred. Bruning and Kintz recommended the F max because of its simplicity.

The F max ratio is obtained by dividing the largest variance obtained by the smallest and referring the quotient to the table of critical values appropriate for this

statistic (5:234-235). The number of degrees of freedom is one less than the number of cases in each sample. The only restriction in the use of the F max ratio is that all samples must have the same size N. The F max ratio was used to test the homogeneity of variances between groups of subjects for each of the blocking directions for three-point and four-point stances.

The t Ratio Test for Significance of Difference Between Means of Correlated Groups

Means for each movement direction for each of the two stances were compared for junior high school boys by use of the t ratio test for significance of difference between means for correlated groups. The t statistic is the ratio of the difference between the two samples. The standard error of difference is calculated by use of the following formula:

$$SE_D = \sqrt{\sigma_{m1}^2 + \sigma_{m2}^2 - 2r_{12} \sigma_{m1} \sigma_{m2}} \quad (13:226-228)$$

The same process was used for senior high school, junior college and college groups.

CHAPTER IV

RESULTS OF THE STUDY

The purposes of this study were: (1) to determine the significance in variability between right, left, forward and backward movement times resulting from assuming the three-point and the four-point center stances, for junior high, senior high, junior college and college football players without previous experience at the center position; (2) to determine the significance of difference between means of right, left, forward and backward movement of the three-point and four-point stances for each of the groups, viz., junior high, senior high, junior college and college.

I. MEANS, VARIANCES AND TESTS OF HOMOGENEITY OF VARIANCE BETWEEN GROUPS

The F max ratio was used to test the significance of difference in variability between directional movement times for two stances among four levels of players. In order to be statistically significant for 11 degrees of freedom and four variances, the F max ratio must be 5.23 (by interpolation) at the .05 level of confidence. As Table I shows, none of the ratios were significant, indicating that for both stances, the variability found could be attributed to chance rather than to any true differences in movement time.

TABLE I

MEANS, VARIANCES AND TESTS OF HOMOGENEITY OF
VARIANCE BETWEEN GROUPS:
THREE-POINT AND FOUR-POINT STANCES

Three-point Stance

	JHS		SHS		JC		C		F max
	*M ₃	σ^2	M ₃	σ^2	M ₃	σ^2	M ₃	σ^2	
R	.750	.100	.711	.040	.676	.030	.709	.049	3.30
L	.698	.040	.671	.030	.622	.049	.651	.010	4.90
FWD	.803	.019	.755	.049	.736	.069	.787	.040	3.63
BKWD	1.216	.059	1.389	.030	1.311	.049	1.249	.030	1.97

Four-point Stance

	JHS		SHS		JC		C		F max
	*M ₄	σ^2	M ₄	σ^2	M ₄	σ^2	M ₄	σ^2	
R	.787	.079	.702	.030	.680	.040	.700	.030	2.63
L	.755	.049	.623	.030	.659	.030	.639	.059	1.97
FWD	.799	.040	.732	.030	.712	.030	.750	.019	2.11
BKWD	1.257	.030	1.367	.040	1.266	.040	1.233	.019	2.11

*M₃ = Mean for three-point stance (5:110)

*M₄ = Mean for four-point stance

II. COMPARISON OF MOVEMENT TIMES WITHIN THE JUNIOR HIGH, SENIOR HIGH, JUNIOR COLLEGE AND COLLEGE

In order to analyze the movement times within the groups, the M₃ mean, (three-point stance) score of each

group was compared to its own M_4 mean (four-point stance) for each movement direction.

Inter-Group Comparison - Junior High (N-12)

Movement Right. The M_3 mean score was .750 second. The M_4 mean score was .787 second. The correlation between the means was .753. The difference between the mean scores was .037. This gave a t ratio of .620 which is not significant at the .05 level of confidence.

Movement Left. The M_3 mean score was .698 second. The M_4 mean score was .775 second. The correlation between the means was .144. The difference between the mean scores was .077. This gave a t ratio of .928 which is not significant at the .05 level of confidence.

Movement Forward. The M_3 mean score was .803 second. The M_4 mean score was .779 second. The correlation between the means was .536. The difference between the mean scores was .004. This gave a t ratio of .074 which is not significant at the .05 level of confidence.

Movement Backward. The M_3 mean score was 1.216 second. The M_4 mean score was 1.257 second. The correlation between the means was .150. The difference between the mean scores was .041. This gave a t ratio of .532 which is not significant at the .05 level of confidence. Refer to Table II.

TABLE II

t - TEST FOR SIGNIFICANCE OF
DIFFERENCE BETWEEN MEANS:
JUNIOR HIGH SCHOOL

Test	M ₃	M ₄	r	diff.	SED	df	<u>t</u>
Right	.750	.787	.753	.037	.060	22	*.620
Left	.698	.775	.144	.077	.083	22	.928
Fwd	.803	.779	.536	.004	.054	22	.074
Bkwd	1.216	1.257	.150	.041	.077	22	.532

*In order to be significant at .05 level of confidence, the t ratio must be 2.07 when df = 22 (13:449).

Inter-Group Comparison - Senior High (N-12)

Movement Right. The M₃ mean score was .711 second. The M₄ mean score was .702 second. The correlation between the means was .741. The difference between the mean scores was .009. This gave a t ratio of .167 which is not significant at the .05 level of confidence.

Movement Left. The M₃ mean score was .671 second. The M₄ mean score was .623 second. The correlation between the mean was .465. The difference between the mean scores was .048. This gave a t ratio of .889 which is not significant at .05 level of confidence.

Movement Forward. The M₃ mean score was .755 second. The M₄ mean score was .732 second. The correlation between

the means was .725. The difference between the mean scores was .023. This gave a t ratio of .426 which is not significant at the .05 level of confidence.

Movement Backward. The M_3 mean score was 1.389 second. The M_4 mean score was 1.367 second. The correlation between the mean scores was .558. The difference between the mean scores was .022. This gave a t ratio of .367 which is not significant at the .05 level of confidence. Refer to Table III.

TABLE III

t - TEST FOR SIGNIFICANCE OF
DIFFERENCE BETWEEN MEANS:
SENIOR HIGH SCHOOL

Test	M_3	M_4	r	diff.	SED	df	t
Right	.711	.702	.741	.009	.054	22	*.167
Left	.671	.623	.465	.048	.054	22	.889
Fwd	.755	.732	.725	.023	.054	22	.426
Bkwd	1.389	1.367	.558	.022	.060	22	.367

*In order to be significant at .05 level of confidence, the t ratio must be 2.07 when $df = 22$ (13:449).

Inter-Group Comparison - Junior College (N-12)

Movement Right. The M_3 mean score was .676 second. The M_4 mean score was .680 second. The correlation between

the mean scores was .817. The difference between the mean scores was .004. This gave a t ratio of .080 which is not significant at .05 level of confidence.

Movement Left. The M_3 mean score was .662 second. The M_4 mean score was .659 second. The correlation between the mean scores was .003. The difference between the mean scores was .003. This gave a t ratio of .060 which is not significant at .05 level of confidence.

Movement Forward. The M_3 mean score was .736 second. The M_4 mean score was .712 second. The correlation between the mean scores was .749. The difference between the mean scores was .024. This gave a t ratio of .400 which is not significant at .05 level of confidence.

Movement Backward. The M_3 mean score was 1.311 second. The M_4 mean score was 1.266 second. The correlation between the mean scores was .878. The difference between the mean scores was .045. This gave a t ratio of 1.452 which is not significant at the .05 level of confidence. Refer to Table IV.

TABLE IV

t - TEST FOR SIGNIFICANCE OF
DIFFERENCE BETWEEN MEANS:
JUNIOR COLLEGE

Test	M ₃	M ₄	r	diff.	SED	df	<u>t</u>
Right	.676	.680	.817	.004	.050	22	*.080
Left	.662	.659	.681	.003	.050	22	.060
Fwd	.736	.712	.749	.024	.060	22	.400
Bkwd	1.311	1.266	.878	.045	.031	22	1.452

*In order to be significant at .05 level of confidence, the t ratio must be 2.07 when df = 22 (13:449).

Inter-Group Comparison - College (N-12)

Movement Right. The M₃ mean score was .709 second. The M₄ mean score was .700 second. The correlation between the mean scores was .606. The difference between the mean scores was .009. This gave a t ratio of .167 which is not significant at the .05 level of confidence.

Movement Left. The M₃ mean score was .651 second. The M₄ mean score was .639 second. The correlation between the mean scores was .942. The difference between the mean scores was .012. This gave a t ratio of .240 which is not significant at the .05 level of confidence.

Movement Forward. The M₃ mean score was .787 second. The M₄ mean score was .750 second. The correlation between

the mean scores was .632. The difference between the mean scores was .037. This gave a t ratio of .740 which is not significant at the .05 level of confidence.

Movement Backward. The M_3 mean score was 1.249 second. The M_4 mean score was 1.233 second. The correlation between the mean scores was .335. The difference between the mean scores was .016. This gave a t ratio of .296 which is not significant at the .05 level of confidence. Refer to Table V.

TABLE V

t - TEST FOR SIGNIFICANCE OF
DIFFERENCE BETWEEN MEANS:
COLLEGE

Test	M_3	M_4	r	diff.	SED	df	t
Right	.709	.700	.606	.009	.054	22	*.167
Left	.651	.639	.942	.012	.050	22	.240
Fwd	.787	.750	.632	.037	.050	22	.740
Bkwd	1.249	1.233	.335	.016	.054	22	.296

*In order to be significant at .05 level of confidence, the t ratio must be 2.07 when $df = 22$ (13:449).

SUMMARY

Of the four groups tested--junior high, senior high, junior college and college, in the four directions of

movement--right, left, forward and backward, no differences between means were found which reached the .05 level of confidence.

CHAPTER V

CONCLUSION

The results of this study indicate that the three-point center stance compared to the four-point center stance in the four directions of blocking movement are not significant at .05 level of confidence. Of the four groups tested--junior high, senior high, junior college, and college--no difference between means was found which reached the .05 level of confidence.

I. RECOMMENDATIONS

Since almost no research at all has been done involving the center position in football, and the writer had to limit his area of research, it is recommended that study be conducted of the force of impact of the block following the movement.

It is also recommended that different foot variations within the stance be tested to see if faster movement is possible in the four directions of movement, and that both left- and right-handed centers be tested to see if there is a difference in movement time following the exchange of the ball from the center to the quarterback.

It is further recommended that a variety of physiques be tested to see which one has the fastest movement time.

Lastly, it is recommended that the subjects be in a complete football uniform and the tests be conducted on a football field.

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APPENDIX

APPENDIX A

FOUR-POINT STANCE



THREE-POINT STANCE



TIMING DEVICE AND MILLISECOND CLOCK

