A CASE STUDY CONCERNING
TIME-MOTION IN ATHLETICS

By
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A Thesis Submitted in Partial Fulfilment of
The Requirements for the Degree of
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and
Recreation

We accept this thesis as conforming to the required standard

The University of British Columbia
June 1968
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Department of Physical Education

The University of British Columbia
Vancouver 8, Canada

Date July 23rd, 1968.
ABSTRACT

In this study, three major questions were investigated with respect to the amount of time in motion spent during four home college basketball games played by the University of British Columbia Thunderbirds. First, the amount of time in motion spent on offense was compared to the amount of time in motion spent on defense. Second, all the positions on offense and defense were compared to the amount of time spent in motion and thirdly, the differences of time spent in motion between the full court press and no press were calculated.

The subjects used for this study were ten male athletes on the 1967-68 University of British Columbia Thunderbird Basketball team. Each team position was tested a total of seven times; twice to perfect the use of stop watches during exhibition games, once to run a percentage of error test on one forward position and four times to obtain scores utilized in this study. This sequence of testing was followed to give the testers time to become proficient in the use of the stop watches.

The data was analyzed in order to obtain:

a) the differences between offensive and defensive time spent in motion.

b) the differences between each of the five positions regarding time spent in motion, offensively and defensively.

c) the difference in time spent in motion between the full court press and no press, both offensively and defensively.
It was concluded on the basis of the data collected that:

1) the defense spent significantly more time in motion than the offense.

2) the right forward spent significantly more time in motion offensively than the right guard.

3) defensively, the center and left forward spent significantly more time in motion than the left guard.

4) there was no significant difference in the amount of time spent in motion using the full court press as against no press, either offensively or defensively.

The differences found in this study were significant at the .05 level of confidence.
TABLE OF CONTENTS

CHAPTER

I STATEMENT OF THE PROBLEM ............................................. 1
II JUSTIFICATION OF THE PROBLEM ....................................... 3
III REVIEW OF LITERATURE ................................................. 4
IV OFFENSE AND DEFENSE OF THE UNIVERSITY OF BRITISH COLUMBIA VARSITY BASKETBALL TEAM ........ 9
V METHOD AND PROCEDURES .................................................. 12
VI RESULTS ................................................................. 18
VII DISCUSSION ............................................................. 25
VIII SUMMARY AND CONCLUSION ......................................... 27

BIBLIOGRAPHY ............................................................... 30

APPENDICES

A PERCENTAGE OF ERROR .................................................. 32
B DUNCAN'S NEW MULTIPLE RANGE TEST ................................ 33
C STUDENT "T" FOR THE OFFENSE VERSUS DEFENSE .................. 34
D INDIVIDUAL SCORE SHEET ................................................ 35
E MASTER SCORE SHEET ..................................................... 36
F RAW SCORES ............................................................... 37

LIST OF TABLES

I PERCENTAGE OF ERROR .................................................. 15
II INFORMATION FOR GAMES PLAYED ..................................... 19
III COMPARISON OF MEAN SCORES BETWEEN OFFENSE AND DEFENSE .................. 19
IV COMPARISON OF MEAN TIMES BY POSITION FOR THE OFFENSE ........................ 20
V COMPARISON OF MEAN TIMES BY POSITION FOR THE DEFENSE ....................... 20
ACKNOWLEDGEMENT

The writer would like to express his deepest gratitude to Dr. P. M. Mullins for the great amount of time, patience and advice that was so willingly given throughout the study.

Sincere thanks are also extended to Mr. A. P. Bakogeorge for his careful scrutiny throughout all statistical procedures and his helpful criticism and encouragement.
<table>
<thead>
<tr>
<th>LIST OF TABLES</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI  MEAN TIMES FOR THE OFFENSE BY POSITION</td>
<td>21</td>
</tr>
<tr>
<td>VII MEAN TIMES FOR THE DEFENSE BY POSITION</td>
<td>22</td>
</tr>
<tr>
<td>VIII COMPARISON OF MEAN TIMES OFFENSIVELY,</td>
<td>22</td>
</tr>
<tr>
<td>FULL COURT PRESS VERSUS NO PRESS</td>
<td></td>
</tr>
<tr>
<td>IX  COMPARISON OF MEAN TIMES DEFENSIVELY</td>
<td>22</td>
</tr>
<tr>
<td>NO PRESS VERSUS FULL COURT PRESS</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER I

STATEMENT OF THE PROBLEM

The purpose of this study was to determine the differences in the amount of time spent in motion by basketball players in the following three areas.

First, the amount of time in motion spent on offense as compared to the amount of time in motion spent on defense. Second, all positions on offense and defense were compared to the amount of time spent in motion. Third, the differences of time spent in motion between games when full court press was used and games when no press was used.

Definition of Terms

(1) Motion - Motion was considered to be any type of movement.

(2) Time in Motion - Time in motion was the amount of time a player spent in motion while the game was in progress.

(3) Offensive Time - Offensive time was the time spent in control of the ball.

(4) Defensive Time - Defensive time was the time spent attempting to obtain the ball.

(5) Full Court Press - Defensive team checks the offensive team as they throw the ball in from out of bounds under their own basket. The defense does not go back to their own end and give the offense half the court to move freely in.
(6) **Zone Defense** - Each player defends a specific area on the court. The defensive player does not follow his man all over the court. When the offensive player passes out of one zone, he is picked up by another defender in the next zone.

(7) **Fast Break** - Advancing the ball as fast as possible down the floor. The object is to gain a man advantage on a slow returning defensive team.

**Limitations**

This study was limited by:

(1) The number of home games played.

(2) The ten subjects of the University of British Columbia Basketball team.

(3) Five examiners using ten stop watches.

(4) The magnitude of experimental error established in two practice games.
CHAPTER II

JUSTIFICATION OF THE PROBLEM

Discussions of sports activities invariably involve the amount of skill and conditioning required by the participants in the playing of certain games. This author, because of his interest in basketball and his belief that it requires a great deal of conditioning to play at the college level, attempted to determine the amount of time in motion involved in a game of college basketball.

Very little research has been done to determine the differences in time spent in motion between the different positions on a basketball team. For an example, what is the difference in time, if any, spent in motion between the center and forward?

Further, most seem to feel that more time is spent in motion when a team uses a full court press than the more orthodox half court defense. An attempt was made to determine what difference really exists, if any, between these varying defenses.
CHAPTER III
REVIEW OF LITERATURE

All studies reviewed, although titled "Time-Motion Studies", dealt with the distance traversed during the game and the length of time it takes to play the game. None had attempted to determine the amount of time spent in motion.

All studies (1, 2, 4, 5, 6, 7) reviewed used the same method of procedure. The apparatus used was a pursuit machine. The machine operates on 110 volt, alternating current. By manually operating the switches in the lower left hand corner, the operator can control the pursuit record and/or scoring which is automatically recorded on the electromagnetic counters in the upper left hand corner. The overall dimensions of the assembled machine are 28 inches in length, 21\frac{1}{2} inches in width, and 7 inches in depth. It is readily portable, weighing about 30 pounds, and when assembled for carrying, resembles a piece of luggage. It can be readied for use in less than five minutes.

Removable metal plates, bearing courts and fields patterned to scale, are a part of the machine. Dimensions are worked out so that one-quarter inch on the metal court equals one foot on the actual playing area (except for football, hockey, soccer, and speedball fields in which the ratio is one-quarter inch to one yard). The same proportions are maintained on the tracing wheel. The tracing wheel is a small wheel, two inches in circumference, which has alternate conductors and non-conductors so arranged that the circuit is closed at each one-fourth interval as the wheel is rolled along the metal plate.
The wheel is electrically connected in the circuit so that the circuit is opened and closed each one-fourth inch (on the metal field) in the movement pattern of the player being followed. As the operator follows the path of a given player, the footage (or yardage) is automatically recorded on the electromagnetic impulse counters.

In 1931, Messersmith and Corey (1) studied the distance traversed by one player in college basketball games. The distance measured was 2.34 miles. A similar study done by Messersmith and Foy (2) in 1938, investigating the distance travelled per game by college basketball players, reported that the distance had increased over the distance travelled in 1931. This could be due to the inclusion of the ten second rule and the rule eliminating the center jump after the scoring of field goals. Foy and Messersmith (3, p. 137) made the following statement:

It was not possible to draw definite conclusions from this study regarding the relative effects of the two rules upon the increase in distance, as no study was made following the inclusion of the ten second rule.

The range of distance travelled in the 1938 study was 3.97 miles as against ranges of 2.25 to 2.50 miles in 1931.

The same authors (2), also found that high school players travelled shorter distances than college players (ranges from 2.65 miles to 3.20 per game at the high school level).

Messersmith and Bucher (4) found that Big Ten Conference Basketball players travelled from 3.46 to 3.89 miles per game and that these distances were very similar to the distances travelled by secondary college players studied in Indiana.
They also concluded that the distances traversed by college players at the time of this study were considerably greater than those traversed by high school players.

In a study comparing men and women, Messersmith, et al (5), concluded that on a basketball court - forty feet by seventy feet - men travelled almost twice as far as women in thirty-two minutes of play but the women used two-court rules to govern their games.

Messersmith and Foy (6) in 1932, found that the distance travelled by three players in three games of college football ranged from 2.02 miles by a guard to 3.64 miles by a halfback.

In 1952, a Time-Motion Study was conducted by Francis (7) involving eight athletic sports in the Big Ten Conference. The sports studied were Badminton, Baseball, Basketball, Boxing, Fencing, Football, Handball and Tennis.

Francis used the pursuit machine method described previously on the eight different sports. In basketball he also included seven time factors, four time-motion factors and thirteen motion factors. This made his study of basketball, much more comprehensive than any previous studies.

Francis found the distance travelled during the basketball games ranged from a low of 1.90 miles by a guard to a high of 3.23 miles by a forward. All of the players studied travelled an average 2.54 miles per game.

In the Time-Motion studies reviewed, the one significant factor is that the amount of distance traversed has increased with the rule changes.
Only in the last study by Francis (7) has it been shown that the positions differ in the amount of distance traversed. This study showed forwards travelled further than guards.
REFERENCES


3. Ibid., p. 137.


CHAPTER IV
OFFENSE AND DEFENSE OF THE UNIVERSITY OF
BRITISH COLUMBIA VARSITY BASKETBALL TEAM

The following descriptions of the Offense and Defense for the University of British Columbia Varsity Basketball Team deal only with the four home games used for this study.

The first two games that were tested were against Alaska Methodist University and the University of Calgary. In both of these games the University of British Columbia used a full court press. In the last two games tested, against the University of Calgary and the University of Manitoba, the coach decided the University of British Columbia should play the normal man to man defense.

Following is the offensive and defensive analysis of the four games played.

Offense

The University of British Columbia played basically a balanced offense commonly called a single post offense. The players kept the five basic positions occupied on the floor; the two forwards in the corners, the two guards out past the top of the key and to either side of it, and finally, the center in a high position on the foul line.

Getting the rebound from a shot by the opposition, the University of British Columbia team started their offense by immediately going to the fast break. The ball travelled from the forwards or center to the guard moving down the floor near the sidelines.
The guard from the other side came into the middle and immediately received the ball. Meanwhile, the forward who did not get the rebound, filled in the other lane on the opposite side of the floor enabling the team to get a three on two situation at the offensive end of the floor.

If there was no quick basket scored, the team then filled in the five basic positions. From this situation they then tried to isolate one-on-one or two-on-two to beat the opposition. In the aforementioned, two-on-two, one man sets a screen and then cuts toward the basket as the man with the ball dribbles by.

In all of the four games played against the other universities, the opposition started by playing a zone defense. In the later stages of the games when they were losing, they were forced to come out of the zone and play man-to-man defense.

Against the zone defense, the University of British Columbia played a one-three-one zone break, in which the players were positioned in the following way; one guard at the top of the key, one forward at the base line to either side of the key but not in it. The other three players were situated in a straight line across the court, in line with the foul line. The center played on the foul line. The man on the base line tried to arrive at the side of the key at the same time the ball was passed around to that side. This enabled them to get two men in the zone where there was only one defender, consequently acquiring an easy shot.
Defense

The University of British Columbia played a man-to-man defense. They switched men only as a last resort if one of their own men was screened out of the play. In the first two games as was explained earlier, the University of British Columbia played a full court press. One man checked the player throwing the ball in and the other four covered certain areas on the floor. They protected a zone and did not check right on the man. If they forced the opposition to make an error and lose the ball or stole the ball, the Thunderbirds immediately went into their offensive play.

Because the University of British Columbia players had problems playing this type of defense, the coach decided not to use it during the last two games that were tested.

The University of British Columbia Thunderbirds were a stronger team than their four opponents and therefore scored quickly. Their superior defense forced the opposing team to work very hard to score. The result was that the University of British Columbia spent more time playing defense than offense.

Better rebounding by the University of British Columbia enabled them to get possession of the ball off the backboards and allowed the opposing teams only one shot at the basket in most cases.
CHAPTER V

METHOD AND PROCEDURES

Subjects

The subjects selected were ten male members of the University of British Columbia Thunderbird Basketball Team, whose ages ranged from 19 to 24 years. Previous to the start of the testing the team had gone through six weeks of strenuous workouts.

Games

The total number of games involved was seven. Two exhibition games were used to familiarize the testers with the testing technique. The third game was used to determine the percentage of error among the scores. The last four games made up the actual study for this thesis.

The first game of the study was against Alaska Methodist University, the second and third games were against the University of Calgary and the fourth and final game was against the University of Manitoba.

Equipment

The equipment used consisted of ten watches borrowed from the School of Physical Education and Recreation. These stop watches were numbered so that each tester always used the same stop watch for each test.

Tests

The total number of tests was seven and they were divided into
two practise trials; one test to determine the percentage of error, and four tests to collect times for the study. In each of the four tests, offensive and defensive times were recorded. This was done for each of the five positions.

**Testers**

There were four people involved in the testing besides the author. The four were school teachers, three of whom were Physical Education instructors well versed in the use of stop watches.

These five people attended all seven games involved in this study and used the same watches throughout the entire study.

Before the first game the testers were called together and an explanation given of the test. They were given the following directions.

1. The stop watches will be running only while time is moving on the score clock. Infractions that cause the clock to stop will also stop the watches; for example, time outs, fouls, injuries, etc.

2. For consistency the two watches will be marked with a (D) for defense and an (O) for offense. Use the defensive watch in the left hand and the offensive watch in the right hand. Push the stop and start button with the index finger.

3. Any type of movement will be classified as motion; for example, passing, rebounding, faking, receiving a pass.

4. Keep the watches on the player or his substitute in the particular position being played.
When the game starts, start one of the watches on the player. When his substitute comes in, record the time from the score clock, then write down the first player's times for offense and defense and then reset the watches.

5. With a rebound, loose ball or fumble, the ball is to be considered in possession of the team that last had control until one or the other again establishes possession or scores.

6. At half time record the times and reset the watches. Record time in minutes and seconds accurately. Write date and team played at the bottom of the sheet.

7. Write up a short resume at the half and end of the game concerning offenses and defenses by both teams; for example, full court press, zone or zone press.

**Administration of Tests**

The testers sat together for the first of the two exhibition games. The times were recorded at half time and the watches reset. To prevent any confusion the watch recording offensive time was always placed in the right hand and the watch recording defensive time in the left. Any problems that arose were discussed at half time. The same procedure was followed for the second exhibition game.

The third game was used to find the percentage of error among the five testers. For this game the five testers were scattered throughout the gymnasium so they could not compare their times with the times of the other investigators until the end of the game. All investigators kept both offensive and defensive times on the same
position and the position selected was the right forward.

To determine the percentage of error, offensive and defensive times taken were changed to minutes and per cent of minutes. For example, 16.30 minutes was recorded as 16.50. The difference between the highest and lowest scores was divided by the average and multiplied by one hundred. See Table 1. The formula used was:

\[
\text{Percentage of error} = \frac{\text{Highest score} - \text{Lowest score}}{\text{mean}} \times 100
\]

**TABLE I**

PERCENTAGE ERROR

<table>
<thead>
<tr>
<th>Offensive Time (In Minutes)</th>
<th>Defensive Time (In Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.63</td>
<td>22.11</td>
</tr>
<tr>
<td>16.53</td>
<td>22.15</td>
</tr>
<tr>
<td>17.61</td>
<td>21.33</td>
</tr>
<tr>
<td>16.75</td>
<td>22.55</td>
</tr>
<tr>
<td>16.58</td>
<td>22.01</td>
</tr>
<tr>
<td>84.10 - Total</td>
<td>110.15 - Total</td>
</tr>
<tr>
<td>16.82 - Mean</td>
<td>22.03 - Mean</td>
</tr>
<tr>
<td>1.08 - Difference between High and Low</td>
<td>1.22 - Difference between High and Low</td>
</tr>
</tbody>
</table>

Per cent error 6.42 Per cent error 5.49

The percentage of error for the offense was 6.42 per cent and for the defense 5.49 per cent. This is considered a low percentage of error.

When all testers were sufficiently acquainted with their duties the games were administered in the following way. Each tester was given the same two watches. The one in the right hand for offense, the left for defense. The watches were stopped and started as the ball changed from offense to defense.
At the end of each half the times were recorded and the watches reset. The times were then totalled at the end of the game.

When all testing was completed, tables were calculated in the following areas:

(1) The amount of time in motion spent on offense as compared to the amount of time in motion spent on defense.

(2) All the positions of offense and defense were compared to the amount of time spent in motion.

(3) The full court press compared to no press, as to the amount of time spent in motion on offense and defense.

*Statistical Treatment*

1. **T-Test** - Because there were only two groups involved, it was found to be more convenient to use the T-test for a comparison between offense and defense.

2. **Analysis of variance** - A two-way analysis of variance technique as advocated by Ferguson (1) was employed to analyze the following data:
   a) The difference between each of the five positions, on offense and defense.
   b) The difference between the full court press and no press, on offense and defense.

3. **Range Test** - This test, Duncan's New Multiple Range Test, as suggested by Edwards (2), was used to analyze the data.

*Detailed statistics used, see Appendix B, Page 33, Appendix C, Page 34.*
REFERENCES


Ten male members of the University of British Columbia Thunderbird Basketball team were involved in a time-motion study to determine:

1. The difference between the offense and defense as to the amount of time spent in motion during a college basketball game.

2. The differences between each of the five positions both on offense and defense as to the amount of time spent in motion during a college basketball game.

3. The difference between a full court press and no press both on offense and defense as to the amount of time spent in motion during a college basketball game.

Five investigators used ten stop watches to determine the amount of time each position was in motion both offensively and defensively.

The total number of tests was seven and these were divided into two practise trials, one trial to determine the percentage of error, and four tests to collect scores for this study.

Table 2 shows dates of games, game scores and the type of defense used in the four games by the University of British Columbia.

It may be of interest to note that the game scores for all four games were fairly similar in spite of the fact the University of British Columbia did not press in the last two games.
TABLE 2
INFORMATION FOR GAMES PLAYED

<table>
<thead>
<tr>
<th>DATE</th>
<th>OPPOSITION</th>
<th>OPPORTION SCORE</th>
<th>U.B.C. SCORE</th>
<th>U.B.C. DEFENSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DECEMBER 22</td>
<td>ALASKA METHODIST UNIVERSITY</td>
<td>60</td>
<td>98</td>
<td>PRESS</td>
</tr>
<tr>
<td>JANUARY 5</td>
<td>UNIVERSITY OF CALGARY</td>
<td>54</td>
<td>99</td>
<td>PRESS</td>
</tr>
<tr>
<td>JANUARY 6</td>
<td>UNIVERSITY OF CALGARY</td>
<td>76</td>
<td>111</td>
<td>NO PRESS</td>
</tr>
<tr>
<td>FEBRUARY 2</td>
<td>UNIVERSITY OF MANITOBA</td>
<td>53</td>
<td>78</td>
<td>NO PRESS</td>
</tr>
</tbody>
</table>

A. OFFENSE VERSUS DEFENSE

The statistical technique used to determine the difference between offense and defense as to the amount of time spent in motion was Students "t" (1).

The t-test was used as a comparison between two means. The results of this analysis appear in Table 3.

TABLE 3
COMPARISON OF MEAN SCORES BETWEEN OFFENSE AND DEFENSE

<table>
<thead>
<tr>
<th></th>
<th>OFFENSE</th>
<th>DEFENSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEAN</td>
<td>17.128</td>
<td>20.338</td>
</tr>
<tr>
<td>TOTAL DEVIATION = 16.05</td>
<td>MEAN DEVIATION = 3.21</td>
<td></td>
</tr>
<tr>
<td>( t = 7.008 )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3 shows that, with a \( t \) of 7.008, the difference is significant at the .01 level of confidence. The time in motion spent on defense was greater than the time in motion spent on offense.
B. DIFFERENCES BETWEEN POSITIONS

An Analysis of Variance was used to determine a significant difference between the different positions. Because no significant difference was found, Duncan's New Multiple Range Test was utilized.

The results of this analysis are noted in Table 4.

<table>
<thead>
<tr>
<th></th>
<th>R.G.</th>
<th>L.F.</th>
<th>L.G.</th>
<th>C</th>
<th>R.F.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16.20</td>
<td>16.94</td>
<td>17.05</td>
<td>17.43</td>
<td>18.03</td>
</tr>
<tr>
<td>R.G.</td>
<td>-</td>
<td>.74</td>
<td>.85</td>
<td>1.23</td>
<td>1.83*</td>
</tr>
<tr>
<td>L.F.</td>
<td>-</td>
<td>-</td>
<td>.11</td>
<td>.49</td>
<td>1.09</td>
</tr>
<tr>
<td>L.G.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.38</td>
<td>.98</td>
</tr>
<tr>
<td>C</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.60</td>
</tr>
<tr>
<td>R.F.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* 1.83 is the only figure that is significant at the .05 level of confidence.

Offensively this test has indicated, at the .05 level of confidence, that the right forward spent more time in motion on offense than did the right guard.

The above method of analysis was applied to the defense to determine the differences in the amount of time spent in motion by each position. The results appear in Table 5.

<table>
<thead>
<tr>
<th></th>
<th>L.G.</th>
<th>R.F.</th>
<th>R.G.</th>
<th>L.F.</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>19.18</td>
<td>20.09</td>
<td>20.40</td>
<td>20.79</td>
<td>21.23</td>
</tr>
<tr>
<td>L.G.</td>
<td>-</td>
<td>.91</td>
<td>1.22</td>
<td>1.61*</td>
<td>2.05*</td>
</tr>
<tr>
<td>R.F.</td>
<td>-</td>
<td>-</td>
<td>.31</td>
<td>.70</td>
<td>1.14</td>
</tr>
<tr>
<td>R.G.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.39</td>
<td>.83</td>
</tr>
<tr>
<td>L.F.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.44</td>
</tr>
<tr>
<td>C</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

R^2 = 1.352
R^3 = 1.417
R^4 = 1.457
R^5 = 1.485
1.61 and 2.05 are the only figures significant at the .05 level of confidence.

Defensively, therefore, this test has indicated at the .05 level of confidence, that the center spent more time in motion than the left guard and the left forward spent more time in motion than the left guard.

C. THE FULL COURT PRESS VERSUS NO PRESS

The final question was to determine the amount of time spent in motion, both offensively and defensively, in games using the full court press and in games where no press was used. The statistical method used to determine differences was Duncan's New Multiple Range Test. Table 6 shows the average times for each position for the two games where the press was used and the average times for each position where the press was not used. It should be noted that these times refer only to the offense.

<table>
<thead>
<tr>
<th></th>
<th>L.F.</th>
<th>C</th>
<th>R.F.</th>
<th>L.G.</th>
<th>R.G.</th>
</tr>
</thead>
<tbody>
<tr>
<td>FULL COURT PRESS</td>
<td>17.28</td>
<td>16.88</td>
<td>18.26</td>
<td>16.85</td>
<td>15.59</td>
</tr>
<tr>
<td>NO PRESS</td>
<td>16.60</td>
<td>17.98</td>
<td>17.79</td>
<td>17.75</td>
<td>16.82</td>
</tr>
</tbody>
</table>

* TIME IN MINUTES

Table 7 shows the average times for each position for the two games where the press was used and the average times for the two games where the press was not used. It should be noted that these times only refer to the defense.
TABLE 7
MEAN TIMES FOR THE DEFENSE
BY POSITION *

<table>
<thead>
<tr>
<th></th>
<th>L.F.</th>
<th>C</th>
<th>R.F.</th>
<th>L.G.</th>
<th>R.G.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRESS</td>
<td>21.34</td>
<td>22.35</td>
<td>19.18</td>
<td>19.47</td>
<td>20.20</td>
</tr>
<tr>
<td>NO PRESS</td>
<td>20.23</td>
<td>20.11</td>
<td>20.30</td>
<td>18.90</td>
<td>20.60</td>
</tr>
</tbody>
</table>

* TIME IN MINUTES

The results for the offense, full court press versus no press, as to the amount of time spent in motion appear in Table 8.

TABLE 8
COMPARISON OF MEAN TIMES OFFENSIVELY
FULL COURT PRESS VERSUS NO PRESS

<table>
<thead>
<tr>
<th></th>
<th>FULL COURT PRESS</th>
<th>NO PRESS</th>
<th>SHORTEST SIGNIFICANT RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRESS</td>
<td>16.874</td>
<td>17.391</td>
<td>.517</td>
</tr>
<tr>
<td>NO PRESS</td>
<td>17.391</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The results indicate that there is no significant difference, when playing on offense, between the use of a full court press and when no press is used.

The results for the defense, no press versus the full court press, as to the amount of time spent in motion appears in Table 9.

TABLE 9
COMPARISON OF MEAN TIMES DEFENSIVELY
NO PRESS VERSUS FULL COURT PRESS

<table>
<thead>
<tr>
<th></th>
<th>NO PRESS</th>
<th>FULL COURT PRESS</th>
<th>SHORTEST SIGNIFICANT RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO PRESS</td>
<td>20.03</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PRESS</td>
<td>20.65</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20.65</td>
<td>R2 = .843</td>
</tr>
</tbody>
</table>
These results also indicate that there was no significant difference, when playing on defense, between the use of a full court press and when no press is used.

Although the measuring techniques used to collect the data may seem crude, the results of this study warrant the following conclusions.

1. The difference between the offense and defense in the amount of time spent in motion was significant at the .01 level of confidence. The defense spent significantly more time in motion than the offense.

2. Offensively, the right forward spent more time in motion than the right guard. This difference is significant at the .05 level of confidence. There were no significant differences found between any of the other positions.

3. Defensively, the center and the left forward spent more time in motion than the left guard. This difference is significant at the .05 level of confidence. There were no significant differences found between any of the other positions.

4. There was no significant difference found between the two games where the press was not used. This applied to both the offense and the defense.
REFERENCES

CHAPTER VII

DISCUSSION

The difference between the time in motion spent on defense as compared to the offense is worthy of some comment. The University of British Columbia Thunderbird Basketball team was much stronger as shown by the scores in Table 1, p. 15. The Thunderbirds were able to take the ball down the floor and score quickly, going then to the defense. The opposing team was unable to score without working a long time for a shot. This could explain the difference in the amount of time spent on defense as compared to the offense.

The results where the right forward moves more than the right guard on offense agrees somewhat with the findings of Francis (7). Francis indicated that the right forward travelled 3.23 miles as compared to 1.9 miles by a guard. This may be further explained by the fact that a majority of guards are right handed and no matter which guard gets the ball he takes it down the right side of the floor. Therefore the forward in obtaining the ball spent more time in motion. However, forwards do move without the ball and the above may only be a part of the answer.

One possible reason that the center spent more time in motion than the left guard is that the center's responsibility on defense is to prevent his man from receiving the ball. He, therefore, has to move more to play in front of the man he is defending. This author is unable to offer any reason for the difference in time spent on defense between the left forward and left guard.
The finding that the full court press does not significantly increase the amount of time in motion spent during a basketball game either on offense or defense is contrary to what most people accept. It seems that teams pressing because they get the ball more, are then able to score quickly. They therefore, get the ball more while on defense and spend more time on offense than the team that plays the orthodox half-court defense.

It would appear to the casual spectator that the tempo of the game is much faster with the full court press and therefore the players must be spending more time in motion in games using the press than in games in which no press is used. One explanation would seem to be that the full court press makes for more exciting basketball and the spectators are therefore more aware of the motion, thus causing them to assume there actually is more motion in the game.

It is extremely difficult to make comparisons with the previous studies done on time-motion. The time element involved in the other studies was the length of the game and because of stopping the clock on all violations and time outs, the total time needed to play the game. None of these studies dealt with the amount of time players spend in motion during an athletic event.
The purpose of this study was firstly, to determine if there was a difference in time in motion spent on defense and offense by the players on a basketball team; secondly to determine the amount of time spent in motion by each position on offense and defense and finally, to determine whether the full court press affects the amount of time spent in motion. The experimental procedure was to use two stop watches on each position to determine the offensive and defensive time in motion. The watches were stopped and started as the ball changed from offense to defense. The times were totalled at half-time and at the end of the game. These tests were run for practise by the testers on two exhibition games. One game was used to find the percentage of error and the final four games tested were used to collect data for this study. The raw scores resulting from each game for each position, offense and defense, full court press and no press were used for statistical analysis and comparison.

The results of this study warrant the following conclusions. It is necessary to recognize that conclusions can be made only within the stated limitations of this study. On the basis of the data gathered, the following results were evident.

1. The difference between the offense and defense in the amount of time spent in motion was significant at the .01 level of confidence. The defense spent significantly more time in motion than the offense.
2. Offensively, the right forward spent more time in motion than the right guard. This difference is significant at the .05 level of confidence. There were no significant differences found between any of the other positions.

3. Defensively, the center and the left forward spent more time in motion than the left guard. This difference is significant at the .05 level of confidence. There were no significant differences found between any of the other positions.

4. There was no significant difference found between the two games where the full court press was used and the two games where the press was not used. This applied to both the offense and the defense.

In spite of the care taken in using the stop watches, it was often very difficult for the alert testers to keep up with the ball which changes hands quickly. Only much additional practise would eliminate the chances of error. The testers interest in the game might have affected the speed with which the stop watches were changed over.

It is recommended that further studies investigate the following:

1. A similar study to the one which has just been described, but involving at least ten games. It is possible that a study involving more games may give different results.

2. A study where more investigators are used to accurately measure players rather than positions. It would be of interest to find out the amount of time spent in motion by each player.
3. A similar study involving equal number of games won and lost. It would be interesting to note if a difference does exist with time spent in motion between games which are won and games which are lost.

4. The differences in the time spent in motion for the offense when playing against a man to man defense as compared to playing against a zone defense.
BIBLIOGRAPHY

BOOKS


PERIODICALS


UNPUBLISHED PAPERS

APPENDICES
### APPENDIX A

**PERCENTAGE OF ERROR**

<table>
<thead>
<tr>
<th>Stop Watches</th>
<th>Offense</th>
<th>Defense</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 16:38</td>
<td>1. 22:07</td>
<td></td>
</tr>
<tr>
<td>2. 16:32</td>
<td>2. 22:09</td>
<td></td>
</tr>
<tr>
<td>3. 17:37</td>
<td>3. 21:20</td>
<td></td>
</tr>
<tr>
<td>4. 16:45</td>
<td>4. 22:33</td>
<td></td>
</tr>
<tr>
<td>5. 16:35</td>
<td>5. 22:01</td>
<td></td>
</tr>
</tbody>
</table>

1. Each number changed to a decimal and totalled.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 16.63</td>
<td>1. 22.11</td>
</tr>
<tr>
<td>2. 16.53</td>
<td>2. 22.15</td>
</tr>
<tr>
<td>3. 17.61</td>
<td>3. 21.33</td>
</tr>
<tr>
<td>4. 16.75</td>
<td>4. 22.55</td>
</tr>
<tr>
<td>5. 16.58</td>
<td>5. 22.01</td>
</tr>
</tbody>
</table>

**TOTAL**

<table>
<thead>
<tr>
<th></th>
<th>84.10</th>
</tr>
</thead>
</table>

2. Average each column.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>16.82</td>
<td>22.03</td>
</tr>
</tbody>
</table>

3. Express the maximum difference as a per cent of the average time in each column.

\[
\frac{1.08 \times 100}{16.82} = 6.42\% \quad \frac{1.21 \times 100}{22.03} = 5.49\%
\]
APPENDIX B

To analyze the scores from the four games tested, two methods were used. The first method was a range test; Duncan's New Multiple Range Test. The second method used was the Students "t".

The level of significance was required to reach .05 to be acceptable. To obtain the answers to the questions, the experimenter entertained the following procedures.

In using Duncan's New Multiple Range Test the average times for the five different positions on offense were put down from the lowest to the highest. These were then compared with one another to find the difference.

<table>
<thead>
<tr>
<th>R.G.</th>
<th>L.G.</th>
<th>C.</th>
<th>R.F.</th>
<th>SHORTEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.20</td>
<td></td>
<td></td>
<td>1.23</td>
<td>1.83</td>
</tr>
<tr>
<td>16.94</td>
<td>.74</td>
<td>.85</td>
<td>1.09</td>
<td></td>
</tr>
<tr>
<td>17.05</td>
<td></td>
<td>.38</td>
<td>.98</td>
<td>R = 1.354</td>
</tr>
<tr>
<td>17.43</td>
<td></td>
<td></td>
<td>.60</td>
<td>R = 1.380</td>
</tr>
<tr>
<td>18.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

At the .05 level of confidence the difference must be above that number appearing in the column marked shortest significant range.

The only score that was significant was 1.83. This showed that on the offense the right forward spent significantly more time in motion than the right guard.
## APPENDIX C

**TIME MOTION STUDY T TEST DATA FOR THE OFFENSE VERSUS THE DEFENSE**

<table>
<thead>
<tr>
<th>OFFENSE</th>
<th>DEFENSE</th>
<th>DEVIATION</th>
<th>DEVIATION$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.94</td>
<td>20.79</td>
<td>-3.85</td>
<td>14.82</td>
</tr>
<tr>
<td>18.02</td>
<td>20.09</td>
<td>-2.07</td>
<td>4.28</td>
</tr>
<tr>
<td>17.43</td>
<td>21.23</td>
<td>-3.80</td>
<td>14.44</td>
</tr>
<tr>
<td>17.05</td>
<td>19.18</td>
<td>-2.13</td>
<td>4.54</td>
</tr>
<tr>
<td>16.20</td>
<td>20.40</td>
<td>-4.20</td>
<td>17.64</td>
</tr>
<tr>
<td>T 85.64</td>
<td>101.69</td>
<td>-16.05</td>
<td>55.72</td>
</tr>
<tr>
<td>X 17.128</td>
<td>20.338</td>
<td>-3.21</td>
<td></td>
</tr>
</tbody>
</table>

\[
SD^2 = \frac{\sum D^2}{N} - \bar{D}^2
\]

\[
= \frac{55.72}{5} - (-3.21)^2
\]

\[
= .840
\]

\[
t = \frac{D}{SD^2} = \frac{D}{SD^2} \frac{SD^2}{N-1}
\]

\[
t = 3.21 \approx 7.008
\]

In comparing the Offense to the Defense in the amount of time being spent in motion a t test was used.

This involved totalling the five mean times for offense and doing the same for defense. The deviation between the two was found, keeping the sign, totalled and then the average taken. The deviations were then all squared and summed.

These figures were then substituted in the formula to find the Standard Deviation squared. The Standard Deviation squared was then substituted into the formula for finding t. This gave the answer for the t test.
APPENDIX D

INDIVIDUAL SCORE SHEET

Time in Motion For Thunderbird Basketball Team

<table>
<thead>
<tr>
<th>Position - Name</th>
<th>Position - Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Offense</td>
<td>Defense</td>
</tr>
<tr>
<td>H</td>
<td>a</td>
</tr>
</tbody>
</table>

TOTAL

Resume:

<table>
<thead>
<tr>
<th>Position</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd Offense</td>
<td>Defense</td>
</tr>
<tr>
<td>H</td>
<td>a</td>
</tr>
</tbody>
</table>

TOTAL

Game

Total

Resume:
APPENDIX E
MASTER SCORE SHEET

<table>
<thead>
<tr>
<th>Game</th>
<th>Left Forward Offense</th>
<th>Left Forward Defense</th>
<th>Center Offense</th>
<th>Center Defense</th>
<th>Right Forward Offense</th>
<th>Right Forward Defense</th>
<th>Left Guard Offense</th>
<th>Left Guard Defense</th>
<th>Right Guard Offense</th>
<th>Right Guard Defense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec. 1</td>
<td>17.58</td>
<td>20.51</td>
<td>16.16</td>
<td>23.41</td>
<td>18.68</td>
<td>19.18</td>
<td>15.08</td>
<td>20.28</td>
<td>14.85</td>
<td>20.05</td>
</tr>
<tr>
<td>Jan. 5</td>
<td>16.98</td>
<td>22.18</td>
<td>17.60</td>
<td>21.30</td>
<td>17.85</td>
<td>20.58</td>
<td>17.61</td>
<td>18.66</td>
<td>16.33</td>
<td>20.36</td>
</tr>
<tr>
<td>Jan. 6</td>
<td>16.86</td>
<td>19.36</td>
<td>17.81</td>
<td>20.16</td>
<td>17.85</td>
<td>20.36</td>
<td>17.43</td>
<td>18.78</td>
<td>17.38</td>
<td>20.68</td>
</tr>
<tr>
<td>Feb. 2</td>
<td>16.35</td>
<td>21.11</td>
<td>18.16</td>
<td>20.06</td>
<td>17.73</td>
<td>20.25</td>
<td>18.08</td>
<td>19.03</td>
<td>16.26</td>
<td>20.53</td>
</tr>
<tr>
<td>TOTAL</td>
<td>67.77</td>
<td>83.16</td>
<td>69.73</td>
<td>84.93</td>
<td>72.11</td>
<td>80.37</td>
<td>68.20</td>
<td>76.75</td>
<td>64.82</td>
<td>81.62</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>16.94</td>
<td>20.79</td>
<td>17.43</td>
<td>21.23</td>
<td>18.02</td>
<td>20.09</td>
<td>17.05</td>
<td>19.18</td>
<td>16.20</td>
<td>20.40</td>
</tr>
</tbody>
</table>
### Defense

<table>
<thead>
<tr>
<th>Game</th>
<th>L.F.</th>
<th>C</th>
<th>R.F.</th>
<th>L.G.</th>
<th>R.G.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>20.51</td>
<td>23.41</td>
<td>19.18</td>
<td>20.28</td>
<td>20.05</td>
</tr>
<tr>
<td>2.</td>
<td>22.18</td>
<td>21.30</td>
<td>20.58</td>
<td>18.66</td>
<td>20.36</td>
</tr>
<tr>
<td>3.</td>
<td>19.36</td>
<td>20.16</td>
<td>20.36</td>
<td>18.78</td>
<td>20.68</td>
</tr>
<tr>
<td>4.</td>
<td>21.11</td>
<td>20.06</td>
<td>20.25</td>
<td>19.03</td>
<td>20.53</td>
</tr>
</tbody>
</table>

### Offense

<table>
<thead>
<tr>
<th>Game</th>
<th>L.F.</th>
<th>C</th>
<th>R.F.</th>
<th>L.G.</th>
<th>R.G.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>17.58</td>
<td>16.16</td>
<td>18.68</td>
<td>15.08</td>
<td>14.85</td>
</tr>
<tr>
<td>2.</td>
<td>16.98</td>
<td>17.60</td>
<td>17.85</td>
<td>17.61</td>
<td>16.33</td>
</tr>
<tr>
<td>3.</td>
<td>16.86</td>
<td>17.81</td>
<td>17.85</td>
<td>17.43</td>
<td>17.38</td>
</tr>
<tr>
<td>4.</td>
<td>16.35</td>
<td>18.16</td>
<td>17.73</td>
<td>18.08</td>
<td>16.26</td>
</tr>
</tbody>
</table>

---

*Press*

*No Press*