1953

A comparison of the initial pressure of the feet in the start as the sprinter leaves the blocks.

Williams, Malcolm Mowry

Boston University

http://hdl.handle.net/2144/9535

Boston University
BOSTON UNIVERSITY
SCHOOL OF EDUCATION

Thesis

A COMPARISON OF THE INITIAL PRESSURE OF THE FEET
IN THE START AS THE SPRINTER LEAVES THE BLOCKS

Submitted by

Malcolm Mowry Williams

(B.S., Boston University, 1951)

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

1953
First Reader: Leslie W. Irwin  
Professor of Education

Second Reader: Joseph G. Dzenowagis  
Instructor in Education
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. THE PROBLEM</td>
<td>1</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Area in which the Problem is Conducted</td>
<td>1</td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td>1</td>
</tr>
<tr>
<td>Significance of the Problem</td>
<td>2</td>
</tr>
<tr>
<td>Needs, Relationships, and Results</td>
<td>2</td>
</tr>
<tr>
<td>Benefit to coaching profession</td>
<td>2</td>
</tr>
<tr>
<td>Advantage of agreement and standard coaching procedure</td>
<td>2</td>
</tr>
<tr>
<td>II. REVIEW OF PREVIOUS STUDIES</td>
<td>4</td>
</tr>
<tr>
<td>III. PROCEDURE</td>
<td>8</td>
</tr>
<tr>
<td>Description of the Spreads</td>
<td>8</td>
</tr>
<tr>
<td>Description of the Apparatus</td>
<td>11</td>
</tr>
<tr>
<td>Procedure Used in Testing Sprinters by the Apparatus</td>
<td>11</td>
</tr>
<tr>
<td>IV. ANALYSIS OF DATA</td>
<td>14</td>
</tr>
<tr>
<td>Personnel Used in Gathering Data</td>
<td>14</td>
</tr>
<tr>
<td>Explanation and Compilation of Data</td>
<td>14</td>
</tr>
<tr>
<td>Observations While Gathering Data</td>
<td>18</td>
</tr>
<tr>
<td>CHAPTER</td>
<td>Page</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>V. SUMMARY AND CONCLUSIONS</td>
<td>19</td>
</tr>
<tr>
<td>Summary</td>
<td>19</td>
</tr>
<tr>
<td>Conclusions</td>
<td>19</td>
</tr>
<tr>
<td>Suggestions for Further Research</td>
<td>21</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>22</td>
</tr>
<tr>
<td>Table</td>
<td>Page</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>1. Initial Green and Red Light Flashes as the Sprinter Leaves the Mark in Four Different Spreads</td>
<td>16</td>
</tr>
</tbody>
</table>
# LIST OF PLATES

<table>
<thead>
<tr>
<th>Plate</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Photographs Illustrating the Four Different Spreads</td>
<td>10</td>
</tr>
<tr>
<td>2. Photograph of the Apparatus</td>
<td>12</td>
</tr>
<tr>
<td>3. Photograph of Drawing to Scale</td>
<td>13</td>
</tr>
</tbody>
</table>
CHAPTER I
THE PROBLEM

1. Introduction

Always having held a definite interest in sprinting, from active competition to the coaching of this event, the writer for some time has felt the need for research into the initial push of a sprinter when he takes off from the blocks; that the knowledge gained from this research might be used to advantage in coaching sprinters.

2. Area in which the Problem is Conducted

The area of the problem has to do with the following two items:
1. The start of the sprint race
2. The initial action or pressure from the sprinter's feet, as he leaves the blocks at the start of the sprint race.

3. Statement of the Problem

A comparison of the initial pressure of the feet in the start as the sprinter leaves the blocks.

This problem, when it is solved by experimental research, will show whether the initial push or pressure by the sprinter, as he leaves the blocks, is from the rear or the front foot.
4. Significance of the Problem

The problem needs study because heretofore the answer has been mostly conjecture. Effectual coaching of sprinters in the technics of starting in the sprints requires technical answers and not guesswork. It was to supply the technical answers that after much study and experimenting an apparatus was devised, designed, and built according to the specifications of the writer, and used to establish the fact as to which foot actually gives the initial push as the sprinter leaves the blocks in four different spreads or starts.

5. Needs, Relationships, and Results

Benefit to coaching profession.— This experimental problem in research could be the basis of discussion among track coaches, which would be of benefit to coaches and a contribution to the profession. Through the results of this experimental research, the fact could be proven and established as to which foot actually gives the initial push, and this conclusion would aid in the coaching of sprinters in the start of a sprint race.

Advantage of agreement and standard coaching procedure.— At the present time, there seems to be a lack of agreement among track coaches concerning the initial push of the feet as the sprinter leaves the blocks. There are coaches in certain sections of the country who coach on the theory that the initial push is from the front foot at the start, as the sprinter leaves the blocks. They put no emphasis on the push from the rear foot, as they seem to feel that the rear leg velocity will develop naturally.
Other coaches, including the writer, advocate pushing from the rear foot first at the start, to develop more velocity as the sprinter leaves the blocks.

This study was made with the thought of standardizing coaching procedure with respect to the initial push as the sprinter leaves the blocks regardless of the spread that is used. There should be a standard coaching procedure in regard to the initial push to aid coaches, especially young coaches, in this phase of the sprint start.
CHAPTER II
REVIEW OF PREVIOUS STUDIES

Some studies have been made on different phases of the sprint start.

A study of the force exerted by the sprinter's feet as he left the blocks in four different spreads or starts was made by Kistler.\(^1\) He measured the front-leg thrust while it was at a 45-degree angle, and the rear-leg thrust when it was nearly parallel to the ground. This was done from the get-set position as the sprinter left the blocks. Thirty sprinters were used in the study.

He did this by attaching to the blocks the platforms of two spring scales, which were sunk below the surface of the track, so that the starting blocks were in a normal position.

The following conclusion was reached: That the elongated spread or start (where the knee of the rear leg is in line with the heel of the front foot when the sprinter is on the mark) resulted in the greatest velocity and power at the start than any of the various spreads or starts used in the study.

Dickinson made a study of the clearance of the starting blocks by the sprinter's feet and recorded the time at 2.5 yards from the starting line. This was done in four different spreads or starts. Twenty-six sprinters were used in the study of the clearance of the starting blocks. Ten sprinters were used in the study where the time was recorded at 2.5 yards from the starting line.

The results were recorded by an automatic chronoscope actuated by a starting gun. The sprinters, in his study, were familiar with the bunch spread or start.

The following conclusions were reached by Dickinson:

1. The average-time clearance of the starting blocks by the sprinter's feet was less in the bunch spread or start (where the toe of the rear foot is in line with the heel of the front foot) than in any of the other three spreads.

2. The average time by the sprinters to reach a point 2.5 yards from the starting line was less when the bunch spread or start was used, in comparison with the other three spreads. (This is somewhat in contradiction to Kistler's finding.)

Henry made a study on the physical principles of force, velocity,


2/Loc. cit.

3/J. W. Kistler, loc. cit.

reaction time, and duration impulse as it applies to the sprint start. Eighteen sprinters were used in this study.

A special type chronograph was constructed. It automatically recorded different phases of dynamics of the start.

The following conclusions were reached by Henry:

1. **Force.** "The maximum rear foot force increases with greater block spacing, but not as regularly as expected, and there is a theoretically unexplained tendency toward lessened force with the elongated stance. The front leg maximum force does not show a very regular trend." [With greater block spacing.]

2. **Velocity.** "... the block velocity increases progressively as the block spacing is lengthened. An elongated stance of twenty-six inches results in the greater velocity leaving the blocks, but the advantage is lost within the first ten yards. Use of the 11-inch bunch start results in clearing the blocks sooner, but with less velocity than secured from the medium stances, resulting in significantly slower time at 10 and 50 yards. Although the rear leg develops considerably more maximum force than the front, the latter contributes twice as much to the block velocity because its impulse has a longer duration."

3. **Reaction time.** "This was defined as the time elapsed between the starting signal and the first movement of response by the runner." It was stated that, "Reaction time is uninfluenced by block spacing."

4. **Duration impulse.** "Duration of the rear leg impulse (which invariably begins before the front leg comes into action) does not change appreciably with the increase or block spacing. ... The duration of the front foot impulse is also observed to increase regularly in the predicted direction as the block spacing is increased. ... The total duration increases progressively with greater block spacing; for each spacing, almost exactly 89% of the duration is due to the front foot impulse."


2/ Ibid., pp. 309, 317.


Henry further stated: "The highest proportion of best runs and the smallest proportion of poorest runs result from starting with a 16-inch stance. A 21-inch stance is nearly as good."

At the time of the writer's study, a limited amount of research had been done on the initial action of the sprinter's feet. No study has been noted where an apparatus with lights has been used to test the initial pressure or push of the sprinter's feet as he leaves the blocks.

1/ Franklin M. Henry, op. cit., p. 317.
CHAPTER III
PROCEDURE

1. Description of the Spreads

As stated, the problem is concerned with the initial action of the
sprinter's feet as he leaves the blocks in four different types of
starts or spreads used at the start of the sprint race.

The four different types of spreads or starts considered in this
experimental study are:

1. The long spread or the first spread used in the crouch start
   by the sprinter where the forward foot is six to eight inches
   from the starting line and the knee of the rear leg is in line
   with the heel of the forward foot.

2. The second spread, designated here as the intermediate spread
   or start, where the forward foot is again placed about eight
   inches from the starting line, and the rear foot has been moved
   forward so that the knee of the rear leg is opposite the instep
   of the forward foot.

3. The third spread, or the spread used by a number of coaches at
different schools and universities including the University of
Rhode Island, where the forward foot is from twelve to sixteen
inches from the starting line, according to the leg length of
the sprinter, and where the rear foot has been moved forward
until the knee of the rear leg is in line or even with the toe of the forward foot.

4. The fourth spread or start, known as the bunch spread or start, where the forward foot has been moved back until it is about twenty inches from the starting line, and the rear foot has been moved forward until the knee of the rear leg is well ahead of the forward foot and the toe of the rear foot is in line with the heel of the forward foot.

The four different types of spreads or starts described and used in this experimental research are illustrated on the following page with corresponding numbers.
1. Long Spread

2. Intermediate Spread

3. Spread Used at University of Rhode Island

4. Bunch Spread or Start

Plate 1. Photographs Illustrating the Four Different Spreads
2. Description of the Apparatus

The starting blocks used in this research are electrically wired. Steel plates the width of the blocks are attached to the front of the blocks by springs of equal strength, and these plates are covered on their upper surface by a rubber covering to prevent the sprinter's spikes from slipping on the bare steel. Spring-loaded switches are placed under the steel plates. Wires are strung from these switches to steel rods about two feet in length which are attached to the rear of each block. These rods form a right angle with the blocks when the blocks are set in position for starting. The wires continue up these rods to the flashlights and are attached to the flashlight batteries inside the cases. A piece of green cellophane paper is placed inside the glass of the flashlight over the rear block, and a piece of red cellophane paper is placed inside the glass of the flashlight over the front block.

3. Procedure Used in Testing Sprinters by the Apparatus

As the sprinter leaves the blocks in the different spreads or starts, the pressure from his feet forces the steel plates down toward the blocks until they contact the spring-loaded switches under the plates. As the plates contact the switches, the flashlights over the blocks light. If the initial push is from the rear foot first, the green light, or the light over the rear block, will flash; but if the initial push is from the front foot first, the red light, or the light over the front block, will flash.
A photograph of the apparatus described on page 11 and used in this research is illustrated below.

Plate 5. The Apparatus
A photograph of a drawing to scale of the apparatus is shown below.

Plate 6. Photograph of Drawing to Scale
CHAPTER IV
ANALYSIS OF DATA

1. Personnel Used in Gathering Data

One hundred young men of different heights, weights, and abilities were taken from the freshman physical education classes and freshman and varsity track squads at the University of Rhode Island for these tests.

The majority of these young men—94 to be exact—were taken from the freshman physical education classes. These young men were tested with the aid of the majors in physical education at the university, as they reported for their classes in physical education throughout the week beginning Monday, December 8th to Friday, December 12th, 1952. These young men were not coached in these starts previous to the tests and were not selected, but taken as a class.

The other six young men used in these tests, members of the freshman and varsity track squads at the University of Rhode Island, were coached previously only in the spread or start used at the university, where the front foot is 12 to 16 inches from the starting line and the knee of the rear leg is placed in line with the toe of the forward foot.

2. Explanation and Compilation of Data

The young men used in this study were tested for initial push or pressure as they left the blocks in four different spreads or starts.
This was done by the aid of the apparatus described on page 11, shown as a photograph on page 12 and as a drawing to scale on page 13.

The four different spreads or starts used in the tests are described on pages 8 and 9 and illustrated on page 10.

After preliminary, warming-up, and stretching exercises were taken by the group, they were tested individually on the four spreads in the following order: (1) long spread; (2) intermediate spread; (3) spread used at University of Rhode Island; and (4) bunch spread. Each member of the group was allowed to take one practice start on each of the different spreads or starts. As the young men were tested, they were told to sprint 30 yards to insure race conditions. They were given the commands: "on your mark," "get-set," and the signal to go. As each young man left the blocks, the initial action of the lights was noted on each spread and the result was recorded. The tests were taken on the usual clay composition track inside a cage, where the light was subdued and where the lights on the apparatus showed clearly and distinctly.

In the table that follows, columns 1, 2, and 3 show the day and the number tested daily on the long spread; columns 2 and 3 show the initial green and red light flashes daily from the long spread. These columns also show the initial green and red light flashes for the week and total per cent on the long spread.

Columns 4 and 5 show the number tested daily on the intermediate spread, and the initial green and red light flashes daily from the
Table 1. Initial Green and Red Light Flashes as the Sprinter Leaves the Mark in Four Different Spreads

<table>
<thead>
<tr>
<th>Daily Tests</th>
<th>Long Spread</th>
<th>Intermediate Spread</th>
<th>University R.I. Spread</th>
<th>Bunch Spread</th>
<th>Total</th>
<th>Daily Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Green Light</td>
<td>Red Light</td>
<td>Green Light</td>
<td>Red Light</td>
<td>Green Light</td>
<td>Red Light</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td>Monday</td>
<td>40</td>
<td>0</td>
<td>37</td>
<td>3</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>Tuesday</td>
<td>21</td>
<td>0</td>
<td>21</td>
<td>0</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td>Wednesday</td>
<td>8</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Thursday</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Friday</td>
<td>21</td>
<td>0</td>
<td>21</td>
<td>0</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td>Total--5 Days</td>
<td>100</td>
<td>0</td>
<td>97</td>
<td>3</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Total--Per Cent.</td>
<td>100</td>
<td>0</td>
<td>97</td>
<td>3</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>
intermediate spread. These columns also show the initial green and red light flashes for the week and the total per cent.

Columns 6 and 7 show the number tested daily on the spread used at the University of Rhode Island and the initial green and red light flashes from this spread. These columns also show the initial green and red light flashes for the week and the per cent from this spread.

Columns 8 and 9 show the number tested daily on the bunch spread and the initial green and red light flashes daily from the bunch spread. These columns also show the initial green and red light flashes for the week and the total per cent in the bunch spread.

Columns 10 and 11 give the initial green and red light flashes daily on all four spreads. These columns also give the total initial green and red light flashes for the week and the total per cent.

Columns 12 and 13 give the per cent daily on the initial green and red light flashes.

The figures at the bottom of Table 1, opposite totals, show in the long spread that the green light, over the rear block, flashed first in all of the 100 testings, indicating the initial push is from the rear foot at the rate of 100 per cent.

In the intermediate spread, the green light flashed first in 97 testings, as compared to the red light, over the front block, which flashed first in three testings. This indicates that the initial push is at the rate of 97 per cent from the rear foot as compared to 3 per cent from the front foot.
In the spread used at the University of Rhode Island, the green light flashed first in all of the 100 testings, indicating that the initial push is from the rear foot at the rate of 100 per cent.

In the bunch spread, the green light flashed first in 86 testings, as compared to the red light which flashed first in 14 testings, indicating the initial push is from the rear foot at the rate of 86 per cent as compared to 14 per cent from the front foot.

The figures 383 and 17 at the bottom of columns 10 and 11 show the number of times the green and red lights flashed first in the testings on the four different spreads during the five-day testing period. The figure 95.8 shows the rate of percentage that the green light flashed first as compared to 4.2 that the red light flashed first.

3. Observations While Gathering Data

As the lights were observed in these tests, it was noted as the feet and blocks were moved closer together, the interval of time between the flashing of the lights became less.

It was also noted that in the long spread, two distinct clicks were heard as the springs attached to the plates were released as the sprinter left the blocks. As the feet and blocks were moved closer together, this became less noticeable, until in the bunch start the two clicks merged into one.
CHAPTER V
SUMMARY AND CONCLUSIONS

1. Summary

The purpose of this study was to show by the use of the lights on the apparatus the initial push of the sprinter's feet as he left the blocks in four different spreads or starts. If the green light over the rear block flashed first, it indicated that the initial push was from the rear foot, but if the red light over the front block flashed first, it indicated that the initial push was from the front block.

2. Conclusions

The conclusions reached from the data compiled from the tests in regard to whether the first push by the young men tested as they left the starting blocks was from the rear or front foot are as follows:

1. In the first three spreads as the green light over the rear block flashed first on an average percentage of 99, it would indicate that the initial push is from the rear foot in these spreads or starts.

2. In the fourth or last spread described—the bunch spread or start—as the green light over the rear block flashed first on a percentage of 86, it would indicate that the initial push is still from the rear foot in this spread or start, but at a lesser percentage as compared to the other three spreads or starts.
3. Of the one hundred young men tested, the results of the tests on the four spreads or starts indicate that the initial push of the sprinter's feet as he leaves the blocks at the start of the sprint race is from the rear foot at an average percentage of 95.8.

It is the hope of the writer that this study will be of interest to all track coaches, and that the resulting discussion will help to unify the coaching of the sprinter as to the initial push of the sprinter's feet as he leaves the blocks in the different spreads.

As shown by this study, the initial push of the sprinter's feet as he leaves the blocks in the different spreads is from the rear foot at an average percentage of 95.8.

It is the thought of the writer from study and observation in coaching sprinters that if emphasis is put on this point by coaches, the sprinter will be more relaxed in the different spreads while on the mark and as he gradually drops his rear heel and lifts to the get-set position.

It is the thought of the writer that as the initial push in the first three spreads is from the rear foot at an average percentage of 99 as compared with a percentage of 86 for the fourth or bunch spread, this lack of tension is more noticeable in the first three spreads.

It is also the thought of the writer that the sprinter's body will be much lower as he leaves the blocks in these three spreads. The lifting of his body will be much more gradual if emphasis in coaching,
as the result of this study on initial push, is put on the rear foot at the start. The writer feels that with the initial push coming from the rear foot, the sprinter's head and shoulders are forced forward over the starting line while he is on the mark in the get-set position and as he leaves the blocks and goes into his stride. This causes a falling forward action of the sprinter's body as he leaves the blocks and goes into his stride. This falling forward action is maintained throughout the race if his head and shoulders remain forward and there is a straight line from the back of his head to the heel of his rear foot. The lead foot would have to drop just in time to keep the sprinter from falling forward too far and losing his balance. This falling action by the sprinter aids him in the race. The writer feels that when the initial push comes from the rear foot, as shown by the study, the sprinter leaves the blocks with the correct action and should maintain it until he crosses the finish line.

The writer, in his coaching of sprinters, makes good use of the apparatus in this study. He has found it very helpful giving definite coaching aid to the sprinter in the mechanics of the start.

3. Suggestions for Further Research

1. A comparative study could be made of the tension of the sprinter's body in the "get-set" position, and as the sprinter leaves the blocks in the four different spreads used in this study.

2. A comparative study could be made of the gradual lifting of the sprinter's body when he leaves the blocks and goes into his stride from the same four spreads.
BIBLIOGRAPHY

