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Date June 2, 1976

A COMPARATIVE ANALYSIS OF THE MODIFIED STANDING START AND THE
MEDIUM CROUCHED START AS THEY RELATE TO SPRINT SPEED

by

SHERWOOD BOUMA

A professional paper submitted in partial fulfillment
of the requirements for the degree

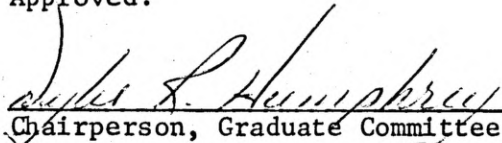
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ABSTRACT

This study was designed to determine if any significant difference in sprint speed resulted from utilizing the medium crouched start as compared to the modified standing start. Ten non-sprinters were selected from the 1975-76 Montana State University men's track team. Three times were utilized for the comparisons of the two types of starts: block clearance, thirty yards, and sixty yards. Block clearance was defined as the amount of time it took each subject to react to the firing of the starting gun and to break contact with the blocks. Thirty yard and sixty yard times were defined as the amount of time it took each subject to cover the two respective distances.

Four testing sessions were conducted using each of the two types of starts. The first and second testing sessions were conducted to collect data on the medium crouched start. The third and fourth testing sessions were conducted to collect data on the modified standing start. During each testing session, each subject ran a total of three sixty yard dashes.

The results were collected and analyzed using mean times, f-tests, and t-tests to determine if any significant differences existed. The findings in regard to the two types of starts are as follows:

1. Mean block clearance time was slower by .12 seconds using the modified standing start. The mean time for the medium crouched start was .73 seconds, and the mean time for the modified standing start was .85 seconds. This difference in times indicated a significant difference at this distance.

2. Mean times for thirty yards indicated no significant differences between the medium crouched start or the modified standing start. Mean thirty yard times for the medium crouched start was 4.46 seconds, and the mean thirty yard time for the modified standing start was 4.45 seconds.

3. Mean times for sixty yards indicated no significant difference between the medium crouched start or the modified standing start. Mean sixty yard time for the medium crouched start was 7.74 seconds, and the mean time for the modified standing start was 7.69 seconds.

Chapter 1

INTRODUCTION

Sprinting has been a part of track since its early beginnings in ancient Greece. Over the years many different styles of starting have been used. Since the turn of the century, sprint starting has been extensively investigated. Among other aspects, investigators have examined the distance between the blocks, the width between the blocks, and the position of the feet on the blocks. Recently, there has been a revived interest in the standing start and its modifications. This study attempted to investigate the effectiveness of the modified standing start as compared to the medium crouched start.

Problem

The general problem of this study was to conduct a comparative analysis of the medium crouched start to the modified standing start as they effect sprinting speed. Specifically, the study attempted to ascertain:

- a. which type of start was most effective for clearing the blocks.
- b. which type of start was most effective for covering the first thirty yards.
- c. which type of start was most effective for covering sixty yards.

Delimitations

For the purpose of this study, the modified standing start was compared to the medium crouched start. Ten non-sprinters from the 1975-76 Montana State University men's track team served as subjects. The times for block clearance, thirty yards and sixty yards, using the medium crouched start were compared to the respective times using the modified standing start.

Limitations

The subjects' diet and daily living habits were not under the researcher's control. The subjects' background and familiarity with either of the two types of starts could also have been a limiting factor. The subjects' attitude, interest, and enthusiasm may also have been a limiting factor on any given testing day.

Definitions

Medium crouch start. The medium crouched start is a starting position in which the knee of the rear leg is positioned such that it is opposite the front of the forward foot when the athlete is on the "on your marks" position (Doherty, 1963). The distance between the front and rear block is approximately sixteen to twenty-two inches. (See Figure C, page 18.)

Modified standing start. The modified standing start is a starting position in which the runner is standing in a ready position.

The front foot is one to two inches from the starting line and the distance between the two blocks is eighteen to twenty-four inches. The body is bent at the waist at a twenty degree angle and the forward foot supports approximately 80 percent of the body weight. (See Figure D, page 18).

Block clearance time. This refers to the amount of time it takes the subject to completely break contact with the blocks with the forward foot.

Thirty and sixty yard times. This represents the amount of time that it takes the subject to cover each respective distance.

Hypothesis

It was hypothesized that there would be no significant difference between the timed results of the subjects' performance when using the modified standing start as compared to their performance when using the medium crouched start at any of the selected distances. The hypothesis was accepted or rejected at the .05 level of significance.

Research Method

A quasi-experimental design was used since the subjects were taken from the men's track team at Montana State University and external validity was questionable. Generalizations based on the results of this study apply only to the sample involved. Internal validity was critical and it was carefully maintained by the techniques

used during the testing sessions and consistency on the part of the investigator in the collection and treatment of data.

Statistical Analysis

T-tests were used to determine if any significant difference existed between the two starting methods at any of the selected distances. The probability of committing a Type I error was set at .05.

Project Justification

Bresnahan and Tuttle (1969) recognized that a good start was a prerequisite to a winning performance. Sylvia (1966) stated that in a meet where competitors have comparable ability, the start of the race can be, and often is, the determining factor in how the athlete finishes. A proper start was viewed by these investigators as a significant factor in the success or failure of a sprinter; therefore, the mechanics involved merit further study.

Chapter 2

REVIEW OF LITERATURE

Various methods of starting have been used by sprinters in an attempt to improve their performance. Early sprinters were reported to have used the standing start. However, this type of start was gradually replaced by the crouched start. Today, the crouched start is accepted by coaches and trainers as the most effective position for faster starting and sprinting (Doherty, 1963).

According to Gibson (1971), the crouched start and its variations have been generally accepted as the most efficient methods, not only for springing the athlete from the blocks, but also for putting him at the correct body angle to achieve top speed.

Recently, there has been renewed interest in the standing start. There have been some modifications of the old standing start and more effective mechanical principles have been applied. Clark (1971), a trainer and equipment designer, has worked on different types of blocks that adapt to the standing start. Clark feels that the crouched start has some disadvantages and that the standing start may prove to be superior.

Crouched Start

Much research has been done concerning the crouched start. The height of the hips, the width of the blocks, the distance that the feet

are from the starting line, the distance between the front and rear blocks, as well as other aspects of sprint starting have been examined.

Hayden and Walker (1933), tested twenty-eight subjects and attempted to determine if holes in the track or blocks would improve performance. The use of blocks produced a significantly lower elapsed time between the sound of the gun and breaking of contact with the blocks by the back foot.

Rasch and Burke (1967) suggested that the position of the legs is important in the start. Sprinters should place their hands as close to the starting line as possible and their feet are slightly behind them rather than under them, in this way giving them more power to push forward.

According to Doherty (1963), the arms should be wider than the shoulders and the weight supported by the fingers. The eyes should be focused on a spot five to twenty feet in front of the starting line. The weight of the body, when in the "set" position, should be distributed such that good balance can be achieved during the initial starting action. The incline of the back in the "set" position should be slightly downward to the shoulders. When the race begins, the sprinter drives as hard as possible from the block with both legs. It is essential that the first few strides be relatively short and made with all the force possible in order to provide the needed acceleration to

reach top speed quickly (Jackson, 1961).

There are three types of crouched starts and each is named for the position of the sprinter's feet. In the bunched start the feet are close together, eleven to fifteen inches apart, and the sprinter's feet tend to be closer to the starting line. In the medium start, the feet are positioned sixteen to twenty-two inches apart and further from the starting line. In the elongated start, the feet are twenty-four to thirty inches apart and still further behind the starting line (Bowerman and Freeman, 1974). In the early 1920's, the "bunched" start was the most commonly used method of sprint starting.

Dickenson (1934) pointed out that the bunched position was faster than any other for clearing the blocks. This conclusion influenced the use of the bunched start and it became the most commonly used method until the 1950's.

White (1935) tested the bunched start in relation to hip elevation and the effect it had on starting time. Starting time was defined as the time interval between the sound of the gun and breaking contact with the blocks by the rear foot. Three different starting positions were timed: high hip, natural hip, and low hip. The research indicated that the high hip position produced the fastest time, the medium hip position was second, and the low hip position was the poorest of the three.

In 1952, the studies pointed out that a man might clear the

the blocks in a shorter time and yet not have either the momentum nor the good balance to get him moving faster down the track (Doherty, 1963). Henry (1952) demonstrated this by testing the efficiency of the three basic types of crouched starts: bunched, medium, and elongated. The medium start was found to give better times for the entire race and the bunched was the poorest. During the next decade, coaches and sprinters followed a wide variety of practices, all depending upon what seemed to work best for them (Doherty, 1963).

Henry (1952) examined the effect of longitudinal block spacing on sprint starting. The feet were positioned such that the distance between the right and left feet were eleven, sixteen, and twenty-two, and twenty-six inches. His subjects ran four, forty yard dashes. He concluded that the sixteen and twenty-two inch longitudinal block placements were the best. He also concluded that the eleven inch block placement was definitely the poorest of the four. While it is true that the bunched start gets the runner out of the blocks quicker, he is actually going slower for the first few yards.

Seegeresth and Grinaker (1962), also studied foot spacing. They examined the relative efficiency of the bunched, medium, and elongated starts at distances of ten, twenty, thirty, forty, and fifty yards. They found that every distance was covered in less time using the medium crouched start.

Stock (1962) studied the bunched, medium, and elongated starts

and the effect that the high hip position had on starting. He found that the medium and the medium high hip starts were faster over twenty yards than either the bunched or elongated starts. Dickenson (1934) also researched longitudinal foot spacings. He found that the bunched start was significantly better than the medium or elongated starts for springing the runner from the blocks.

Malcolm (1962) also determined that the medium crouched and medium crouched start with higher hip placement were significantly faster than the bunched or elongated start. O'Connor (1971) said that the crouched start is better than the old standing start, and that the medium crouched start is more effective than the bunched start for getting the sprinter away in good position and into full stride.

Many coaches and trainers have shown that the medium crouched start is the most effective for getting the sprinter from the blocks and through the entire race is the most effective and efficient manner. They also feel that the front foot should be placed as close to the starting line as possible, about sixteen inches or within the range of comfort. The longitudinal block spacing between the feet is not critical, but is a well-defined range of sixteen to twenty-two inches (Doherty, 1962).

Standing Start

Recently there has been renewed interest in the standing start and some coaches are practicing the use of it for some athletes.

According to Bowerman (1974) remaining upright is so important that even in the sixty yard dash, quite a strong case can be made for the standing start over the crouched position. Davis, the 1960 Olympic 400-meter champion, and Tarr, an NCAA hurdles champion, were able to cover forty yards .20 seconds faster from the standing start than from the crouched start. Both went back to the crouched positions only because they felt foolish standing at the starting line while everyone else in the race was down in the blocks.

In the standing start, the rear block is at an angle of eighty-five to ninety degrees, and approximately two feet behind the front block. After the command "on your marks", the sprinter places his forward foot flat against the front block. The rear foot is similarly placed against the rear block. The back is parallel to the ground, the head is down, and hands rest just above the forward knee. The hands support the body weight in the ready position. In the "set" position, the arms are moved into a counter action position. If the right foot is forward, the left arm is brought forward and the right arm is brought back. At the sound of the gun the sprinter drives out with both legs and initiates the first step. There is no raising up. The sprinter should remain looking down for the first few steps to maintain the driving action.

O'Connor (1971) stated that if one could get a sprinter to drive off the blocks into full stride without having to raise up gradually

from a crouched position, times would be faster using the standing start. Not only will the contestant be closer to the line at the start of the race and thus have to run less distance, but body position is already assuming a nearer to running position (Powell, 1971).

Clark (1971) felt that the standing start was more natural because it allows the athlete to utilize gravity by falling into the first step, rather than trying to overcome it as is the case in the crouched start. He also stated that the crouched start is weakened by the little jab steps which are dictated by the low angle of the knees.

Nutter (1973) has compared the effectiveness of the standing start with the three types of crouched starts at distances of twenty and thirty yards. He found that the standing start was faster than the elongated start, but found no significant differences between the times of sprinters using the standing start and medium or bunched starts.

Extensive study of the standing start has been done by Short of South Africa. He determined that there was a slower reflex reaction at the sound of the gun in the standing start as compared to the crouched start. However, he felt that if an athlete would spend the time to learn the standing start, his time would be faster over the entire race (Gibson, 1970, Nutter, 1973).

Summary

The crouched position was found to be far superior to the old standing start. Of the three types of crouched positions, the medium

crouched start was found to be the most effective throughout the entire race. With the revived interest in the standing start, questions are being raised by coaches and trainers alike as to the comparative effectiveness of the two types of starts.

Mechanically, the crouched start appears to defy the laws of stability. The crouched start causes an extreme displacement of the center of gravity outside the base of support. This makes the runner's position unstable in the direction of the desired movement. The sprinter may make the position even more unstable by increasing the elevation of the hips or the knees in the set position. Upon starting, the sudden extension of the hips will elevate the shoulders, throwing the center of gravity ahead of the feet, and thus causing the body to assume an extreme forward lean for which the runner must compensate. When the race starts, the sprinter drives as hard as possible with both legs. It is essential that the first few strides be relatively short and made with all the force possible in order to provide the needed acceleration to reach top speed quickly. The body gradually rises until full speed has been reached. This displacement of the center of gravity tends to create instability in the crouched start and in the first few strides in sprinting (Rasch and Burke, 1967).

Another cause of instability in the crouched start is the fact that the sprinter must reverse the position of the arms. This quick

reversal means that the runner must make an extra motion before he can actually get himself under way (Clark, 1971).

In the modified standing start, the runner literally falls into the correct running angle and into a natural running stride. The arms are also in the proper position for running since they are in the counter action position when he assumes the "set" position. There is no need for any change of position at the start of the race (Clark, 1971).

Both the crouched start and the modified standing start have mechanical advantages and disadvantages. Neither position can utilize all of the mechanical principles to their fullest advantage. The question becomes one of determining which position can utilize mechanical advantages to the greatest degree to aid in faster starts and sprinting.

Chapter 3

METHODS

Subjects

Ten subjects were selected from the 1975-76 Montana State University men's track team. These subjects were selected from events other than sprinting in order to eliminate the effect of previous learning as much as possible. All subjects were participating in a conditioning program at the time of this study.

Procedures

Four testing sessions were established. During the first and second sessions the subjects were tested using the medium crouched start. During the third and fourth sessions, the subjects were tested using the modified standing start. The schedule for each testing session began with a general warm up. This included light running, general calisthenics, and stretching exercises. To complete the test each subject was called to his mark, then to the "set" position, and finally the gun was fired for the start. Each subject was scheduled to run three sixty yard dashes during each one hour testing session. If there were any absentees, a separate testing date was set as a make-up session. Subjects wore cotton shorts, a track shirt, and standard track shoes.

Equipment

The running surface was a clay mixture which constitutes the floor of the Montana State University Fieldhouse. Gill starting blocks were adapted for this study so that block clearance time could be obtained. A wooden block was attached to the frame by using a long blot in place of the usual metal block. This wooden block was three and one-half inches high, three and one-half inches wide, and five inches long. The surface against which the runner placed his foot was cut at a forty-five degree angle. An eight inch metal rod three sixteenths of an inch in diameter, was attached to this block. A six inch by eight inch rigid metal flag was attached to this rod. (See Figure A, page 17.) As the runner placed his foot against the block, the flag was lifted off the ground about four inches. When the runner broke contact with the block, the flag fell, which broke the light beam, causing the block clearance timer to stop.

Three electronic timers were used. The Electronics Research Laboratory at Montana State University set up the timers for this study. The starting gun was attached to the timers and as the gun was fired all three timers were activated simultaneously.

The first timer was attached to the adapted blocks to obtain the block clearance time. Block clearance time was registered when the metal flag fell across a light beam which broke the electrical circuit and caused the first electronic timer to stop. (See Figure B, page 17.)

The second and third timers were set at the thirty and sixty yard marks and monitored the thirty and sixty yard times. (See Figure E, page 19.) As each subject ran through the thirty and sixty yard light beam gates, the electric circuit was broken, stopping each respective timer.

Block clearance, thirty, and sixty yard times were collected on each subject. Means were computed for each of the three distances, using each of the two starts. T-tests were used to compare the data from the modified standing start with data from the medium crouched start.

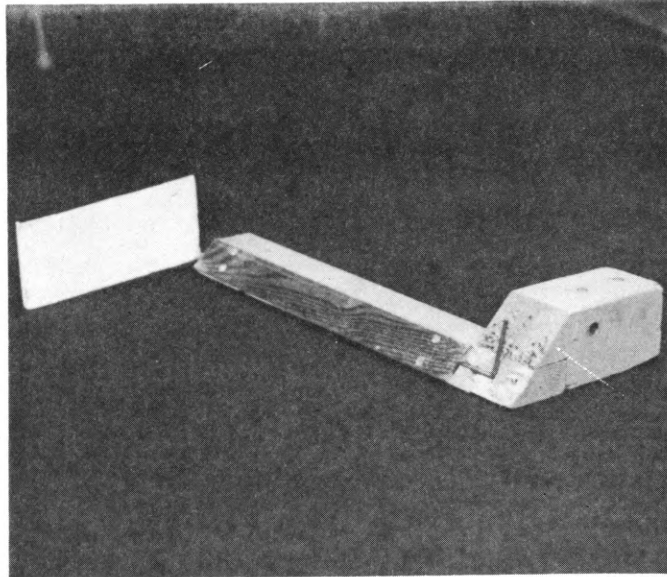


Figure A. Adapted wooden block.

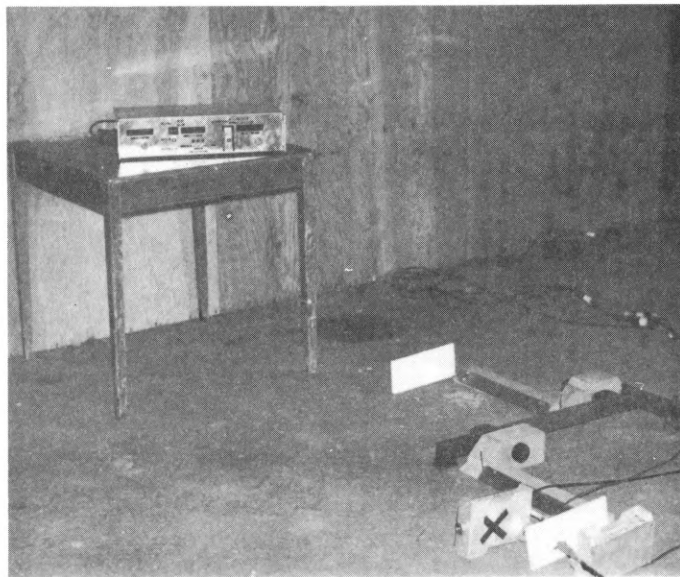


Figure B. Adapted blocks, block clearance light gate, block clearance timer.



Figure C. Medium crouched start.

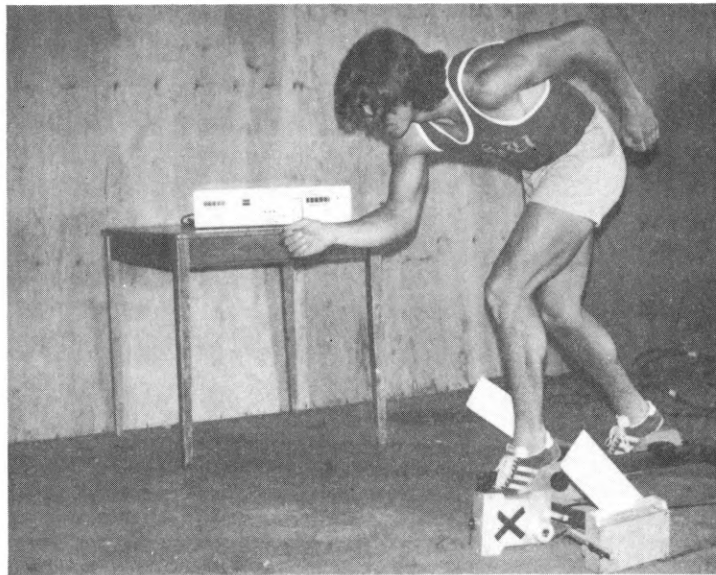


Figure D. Modified standing start.

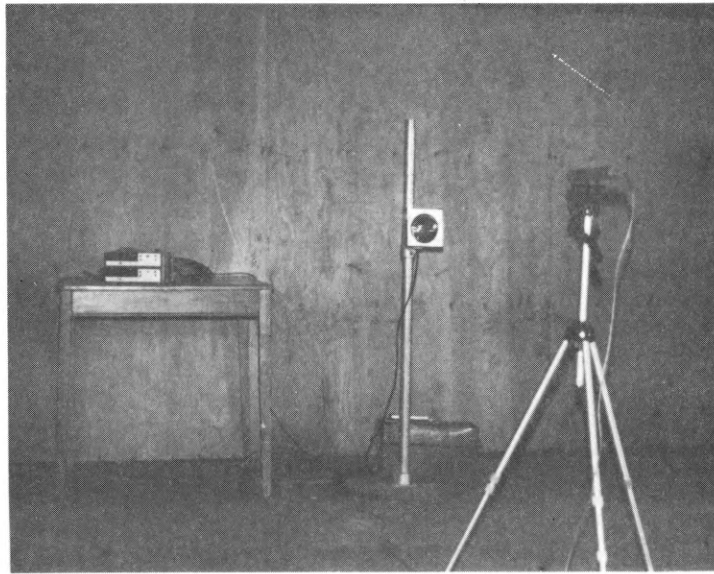
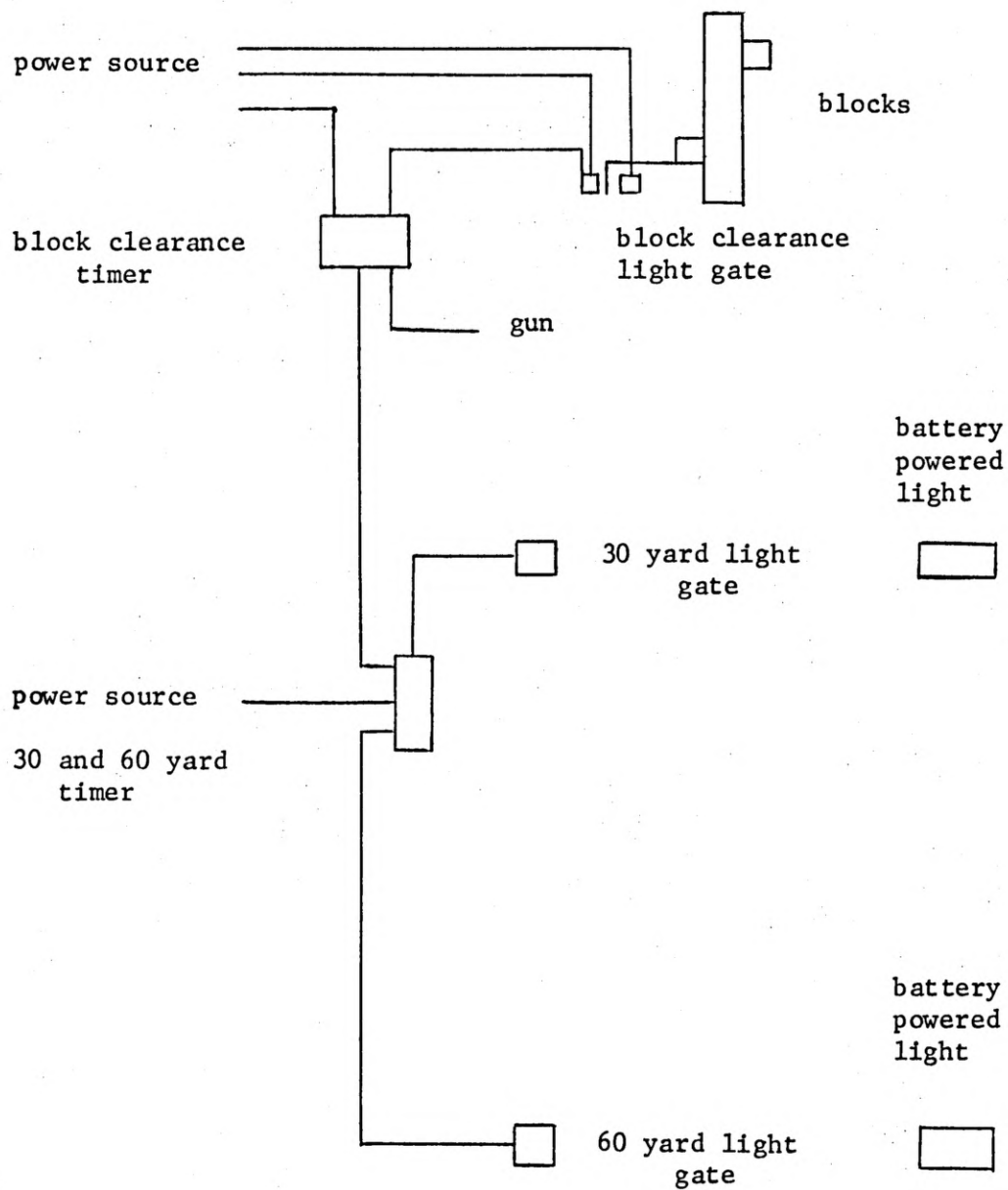


Figure E. Thirty and sixty yard block clearance light gate and timer.

An electronic circuit diagram of the electronic timers and light gates used in this study.



Chapter 4

ANALYSIS OF DATA

The purpose of this study was to determine if any significant difference in sprint speed resulted from the use of the medium crouched start as compared to the use of the modified standing start.

Each subject participated in four testing sessions. The first and second sessions were conducted to collect data on the medium crouched start and the third and fourth testing sessions were conducted to collect data on the modified standing start. During each testing session, each subject ran three sixty yard dashes and times were collected for block clearance, thirty yards, and sixty yards.

The data was processed utilizing a Sigma VII computer at the Montana State University Computer Center. Means, standard deviations, variances, f-ratios, and t-tests were used to determine if any significant differences existed between the results of the two starts at any of the timed distances.

The critical value for T was 2.11. Any t value greater than 2.11 was determined to be significant beyond the .05 level.

The following comparisons were made to determine if practice had any effect or if any learning took place. The mean times for block clearance, thirty yards and sixty yards for the first testing sessions were compared to the mean times for block clearance, thirty yards and sixty yards for the second testing session. The same procedure was

followed for testing sessions three and four.

The results of these comparisons are presented in the following tables.

Table 1

Means, Standard Deviations and t-Values
using the Medium Crouched Start

Item	N	Mean	S.D.	t-value
*BC				
First test	10	.72	.051	.251 ns
Second test	10	.73	.055	
30 Yards				
First test	10	4.45	.249	.244 ns
Second test	10	4.48	.245	
60 Yards				
First test	10	7.72	.459	.268 ns
Second test	10	7.78	.442	
*block clearance				
ns - no significant difference ($p < .05$)				

Table 2

Means, Standard Deviations and t-Values
Using the Modified Standing Start

Item	N	Mean	S.D.	t-value
*BC				
First test	10	.86	.058	.902 ns
Second test	10	.84	.045	
30 Yards				
First test	10	4.45	.223	.207 ns
Second test	10	4.47	.186	
60 Yards				
First test	10	7.69	.443	.069 ns
Second test	10	7.71	.399	
*Block Clearance				
ns - no significant difference (P < .05)				

The t-values presented in Tables 1 and 2 between each of the three respective times did not exceed the critical value of 2.11 at any of the timed distances, therefore, a practical or learning effect did not take place between testing sessions one and two or between testing sessions three and four.

An f-ratio was used to determine if there was a difference in the variability of the subjects in either the medium crouched start or the modified standing start. An effort was made to determine if the subjects were more consistent using either of the two starts at any of

the three timed distances. Results of these comparisons are presented in Table 3.

Table 3

Variability Comparisons of the Modified Standing Start
and the Medium Crouched Start at each Distance

Item	N	Variance	f-test
Block Clearance			
Standing Start	10	.225	1.096 ns
Crouched start	10	.247	1.096 ns
Thirty Yards			
Standing Start	10	.410	1.396 ns
Crouched Start	10	.561	1.296 ns
Sixty Yards			
Standing Start	10	.167	1.202 ns
Crouched Start	10	.201	1.202 ns
ns - no significant difference ($p < .05$)			

The critical value for the f-ratio was 2.98 and any f-value less than 2.98 would show no difference in variances.

The critical value for f was set at 2.98 ($p < .05$) and the f value presented in Table 3 did not exceed this value at any of the timed distances. Therefore, indicating that there was no differences in variability among the subjects in their use of the two types of starts.

The final procedure in the analysis of data was to determine if a significant difference existed between the medium crouched start and the modified standing start at any of the three respective distances of block clearance, thirty yards and sixty yards. The results of these comparisons are presented in Table 4.

Table 4

Means, Standard Deviations and t-Values
of the Two Starts at Each Distance

Item	N	Mean	S.D.	t-value
Block Clearance				
Standing start	10	.85	.057	5.703*
Crouched start	10	.73	.049	5.703*
Thirty Yards				
Standing start	10	4.45	.237	.081
Crouched start	10	4.46	.203	.081
Sixty Yards				
Standing start	10	7.69	.408	2.66
Crouched start	10	7.74	.448	
*Significant beyond the .05 level				

The t-value presented in Table 4 for block clearance was 5.703. This exceeds the critical value of 2.11 which indicates a significant difference. The mean times present in Table 4 show that the block clearance times for the standing start were .12 seconds slower than

those of the medium crouched start.

The data presented in Table 4 indicates that there was no significant difference in sprinting speed when using the medium crouched start or the modified standing start at the thirty yard distance. The t-value of .081 is much less than the critical value of 2.11. The mean time at thirty yards for the medium crouched start was 4.46 seconds and the mean time for the modified standing start was 4.45 seconds.

The t-value for sixty yards was 2.66 which is less than the critical value of 2.11. The mean time for the medium crouched start was 7.74, and the mean time for the modified standing start was 7.69. The t-value and the mean times for the two starts indicates that there is no significant differences in sprinting speed when using the medium crouched start or the modified standing start at the distance of sixty yards.

Discussion

A study done by Short indicates that there was a slower reaction time at the sound of the gun using the modified standing start (Gibson, 1970, Nutter, 1973). The results of this study also indicate that times for block clearance were slower using the modified standing start. Doherty (1963) stated that the medium crouched start got the runner off the blocks and down the track more rapidly than the bunched or elongated starts. Although the bunched and elongated starts were not utilized for this study, the medium crouched start was superior to the modified

standing start for clearing the blocks. Clark (1971) stated that the crouched start is weakened by the little jab steps which are dictated by the low angle of the knees. The center of gravity is also displaced outside the base of support in the medium crouched start; but the sprinter seems to use these disadvantages to clear the blocks more quickly than when using the modified standing start. O'Connor (1971) stated that an individual using the standing start is in a more natural running position and standing closer to the starting line. This may be true, but the mean times for block clearance indicates that the modified standing start is inferior to the medium crouched start at clearing the blocks.

There was no significant difference between the two types of starts at thirty or sixty yards. The sprinter was able to clear the blocks faster using the medium crouched start. However, times for the thirty and sixty yard distances were no faster than when using the modified standing start. The mean times at thirty yards are almost identical. Therefore, the supposed disadvantages of the medium crouched start have been overcome within thirty yards. This would tend to give support to the theory that sprinters achieve top speed within twenty to thirty yards. Another possibility regarding the two starts is the familiarity of the subjects to the medium crouched start. Even though subjects were non-sprinters one must assume that they have seen or been exposed to other athletes who did use some form of the crouched

start.

Both starts have advantages and disadvantages, but neither start can utilize all of the mechanical principles to its fullest advantage.

Neither start is superior to the other at thirty or sixty yard distances.

Chapter 5

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

This study was designed to determine if any significant difference in sprinting speed resulted from utilizing the medium crouched start as compared to the modified standing start. Ten non-sprinters were selected from the 1975-76 Montana State University men's track team. Three times were utilized for the comparisons of the two types of starts: block clearance, thirty yards, and sixty yards. Block clearance was defined as the amount of time it took each subject to react to the firing of the starting gun and to break contact with the blocks. Thirty and sixty yards times were defined as the amount of time it took each subject to cover the two respective distances.

Four testing sessions were conducted using each of the two types of starts. The first and second testing sessions were conducted to collect data on the medium crouched start. The third and fourth testing sessions were conducted to collect data on the modified standing start. During each testing session each subject ran a total of three sixty yard dashes.

The results were collected and analyzed using mean times, f-tests, and t-tests to determine if any significant differences existed. The findings in regard to the two types of starts are as follows:

1. Block clearance mean time was slower by .12 of a second using the modified standing start. The mean time for the medium

crouched start was .73 seconds, and the mean time for the modified standing start was .85 seconds.

2. Thirty yard mean time indicated no significant differences using either the medium crouched start or the modified standing start. Mean time for the medium crouched start was 4.46 seconds and the mean time for the modified standing start was 4.45 seconds.

3. Sixty yard mean times indicated no significant differences using either the medium crouched start or the modified standing start. Mean time for the medium crouched start was 7.74 seconds, and the mean time for the modified standing start was 7.69 seconds.

Conclusions

The following conclusions can be made based on the results of the study.

1. There was a significant difference between the two types of starts in block clearance time. The mean time for block clearance using the medium crouched start was .12 seconds faster than the mean block clearance time for the modified standing start.

2. There was no significant difference in mean times at the distance of thirty yards.

3. There was no significant difference in mean time at the distance of sixty yards.

4. The null hypothesis was rejected for block clearance, but

retained for thirty and sixty yards.

Recommendations

It is recommended that further study be carried out in the area of sprint starting, and particularly involving the standing start.

The following recommendations are posed for future studies:

1. A study using more subjects could be utilized to enable a wider range of comparisons to be made and more individual differences to be analyzed in relation to the two types of starts.

2. Female subjects could be utilized to determine if the female anatomical differences would have an effect in relation to the two types of starts.

3. The effects that height and length of levers have on the two types of starts could be studied.

4. Non-athletes could be used in order to eliminate the effects of previous learning as much as possible.

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APPENDIXES

Subject A

Medium Crouched Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.76	.65	.68	.70
30 yards	4.19	4.15	4.12	4.15
60 yards	7.24	7.14	7.14	7.17
Second test				
Block clearance	.72	.68	.71	.70
30 yards	4.22	4.20	4.18	4.20
60 yards	.733	7.34	7.27	7.31

Modified Standing Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.80	.72	.88	.80
30 yards	4.18	4.08	4.18	4.15
60 yards	7.23	7.16	7.15	7.24
Second Test				
Block Clearance	.76	.87	.83	.82
30 yards	4.22	4.32	4.26	4.27
60 yards	7.15	7.31	7.27	7.24

Subject B

Medium Crouched Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.74	.72	.74	.73
30 yards	4.23	4.25	4.29	4.25
60 yards	7.24	7.29	7.36	7.30
Second test				
Block clearance	.81	.70	.67	.69
30 yards	4.24	4.24	4.17	4.22
60 yards	7.30	7.28	7.22	7.20

Modified Standing Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.89	.95	.90	.91
30 yards	4.30	4.26	4.23	4.26
60 yards	7.32	7.26	7.39	7.33
Second test				
Block clearance	.86	.80	.90	.85
30 yards	4.29	4.25	4.30	4.28
60 yards	7.35	7.26	7.39	7.33

Subject C

Medium Crouched Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.67	.71	.73	.70
30 yards	4.30	4.33	4.32	4.32
60 yards	7.66	7.52	7.61	7.40
Second test				
Block clearance	.73	.67	.71	.70
30 yards	4.32	4.41	4.12	4.38
60 yards	7.49	7.52	7.77	7.60

Modified Standing Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.84	.73	.89	.82
30 yards	4.42	4.32	4.44	4.39
60 yards	7.60	7.48	7.64	7.61
Second test				
Block clearance	.77	.85	.83	.82
30 yards	4.45	4.45	4.41	4.50
60 yards	7.55	7.62	7.64	7.61

Subject D

Medium Crouched Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.66	.57	.72	.65
30 yards	4.52	4.38	4.55	4.49
60 yards	7.93	7.74	7.93	7.87
Second test				
Block clearance	.66	.71	.65	.67
30 yards	4.54	4.54	4.51	4.53
60 yards	8.01	8.07	7.96	8.01

Modified Standing Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.78	.76	.88	.79
30 yards	4.56	4.59	4.35	4.50
60 yards	7.98	8.07	7.74	7.93
Second test				
Block clearance	.69	.72	.81	.74
30 yards	4.47	4.45	4.56	4.49
60 yards	7.84	7.80	7.91	7.85

Subject E

Medium Crouched Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.79	.79	.76	.78
30 yards	4.31	4.39	4.41	4.37
60 yards	7.51	7.59	7.64	7.58
Second test				
Block clearance	.69	.76	.78	.74
30 yards	4.35	4.38	4.37	4.37
60 yards	7.56	7.65	7.64	7.61

Modified Standing Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.89	.92	.94	.92
30 yards	4.44	4.41	4.45	4.43
60 yards	7.63	7.53	7.62	7.59
Second test				
Block clearance	.82	.84	.80	.82
30 yards	4.32	4.39	4.38	4.38
60 yards	7.59	7.62	7.68	7.63

Subject F

Medium Crouched Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.66	.72	.69	.69
30 yards	4.20	4.22	4.23	4.22
60 yards	7.21	7.19	7.26	7.23
Second test				
Block clearance	.67	.71	.70	.69
30 yards	4.28	4.23	4.28	4.26
60 yards	7.43	7.27	7.45	7.38

Modified Standing Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.85	.84	.81	.83
30 yards	4.18	4.27	4.22	4.23
60 yards	7.26	7.35	7.30	7.30
Second test				
Block clearance	.93	.87	.85	.88
30 yards	4.31	4.22	4.20	4.24
60 yards	7.37	7.25	7.23	7.28

Subject G

Medium Crouched Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.72	.67	.71	.70
30 yards	4.35	4.42	4.48	4.41
60 yards	7.42	7.55	7.63	7.53
Second test				
Block clearance	.65	.82	.71	.73
30 yards	4.44	4.47	4.55	4.48
60 yards	7.56	7.57	7.67	7.60

Modified Standing Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	1.03	.93	.92	.96
30 yards	4.40	4.36	4.31	4.35
60 yards	7.52	7.40	7.36	7.43
Second test				
Block clearance	.86	.89	.94	.90
30 yards	4.36	4.46	4.47	4.43
60 yards	7.38	7.50	7.54	7.47

Subject H

Medium Crouched Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.75	.76	.73	.75
30 yards	4.79	4.76	4.74	4.76
60 yards	8.24	8.25	8.30	8.26
Second test				
Block clearance	.78	.74	.77	.76
30 yards	4.88	4.86	4.90	4.88
60 yards	8.45	8.40	8.32	8.46

Modified Standing Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.87	.87	.85	.83
30 yards	4.59	4.74	4.76	4.76
60 yards	8.15	8.32	8.29	8.25
Second test				
Block clearance	.88	.89	.85	.87
30 yards	4.69	4.65	4.65	4.66
60 yards	8.18	8.13	8.17	8.16

Subject I

Medium Crouched Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.83	.81	.86	.83
30 yards	4.83	4.79	4.87	4.83
60 yards	8.34	8.41	8.58	8.41
Second test				
Block clearance	.96	.88	.74	.86
30 yards	4.75	4.86	4.71	4.79
60 yards	8.25	8.42	8.29	8.32

Modified Standing Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	1.00	.85	.90	.91
30 yards	4.25	4.81	4.89	4.89
60 yards	8.26	8.38	8.41	8.34
Second test				
Block clearance	.88	.89	.86	.86
30 yards	4.56	4.75	4.73	4.75
60 yards	8.15	8.26	8.16	8.18

Subject J

Medium Crouched Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.73	.68	.71	.71
30 yards	4.28	4.78	4.73	4.78
60 yards	8.39	8.28	8.20	8.29
Second test				
Block clearance	.73	.77	.77	.76
30 yards	4.73	4.75	4.74	4.74
60 yards	8.19	8.29	8.22	8.23

Modified Standing Start

	1st run	2nd run	3rd run	Average
First test				
Block clearance	.88	.81	.88	.86
30 yards	4.70	4.67	4.72	4.78
60 yards	8.13	8.08	8.15	8.29
Second test				
Block clearance	.84	.87	.84	.85
30 yards	4.67	4.68	4.78	4.71
60 yards	8.42	8.13	8.28	8.28