"EFFECT OF POSITIONING ANGLE AND FRONT BLOCK SPACING ON ACCELERATION DURING THE CURVE START"

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It is known that in the sprint events 'start' place an important role winning a race depends upon how much quicker and faster the athlete leaves the blocks. The purpose of the study was to find out the ideal curve start technique which an athlete can leave the blocks as quickly as possible with the greatest possible velocity. The parameters that affect are reaction time, releasing velocity and front and rear blocks from the starting line, angle of the stoppers, pedals parallel distance between the blocks etc.

Taking crouch start of curves further poses some challenge for the athletes in terms of the positioning angle and block distance. According to the latest rule of allotting specific lanes from second lane onwards complicates the matter still furtherbecause, one of the factors that effect the runner is the matter of curvature of the lane. The lanes are markedly different in this respect, with the inside line having greatest curvature. The strength of the sprinter is used to produce the greatest linear acceleration possible and after he has reached his maximum velocity, he must have strength to maintain it. If the runner is to run the arc of a semi-circle, then he experiences centrifugal force which tends to pull him out-wards. The runner learns to use his body weight to counteract the centrifugal force by learning in to the turn. This produces an acceleration of right angles to the direction and must reduce his speed. The result of this analysis is to point out the well-known fact the sprint times on the curve are slower than on the straight. It is also clear that the runner in the outside lane will experience much less drag than the runner on the inside. Based on the above discussion the present study was planned to investigate the effect of positioning angle and front block spacing on acceleration performance during the curve start.

Delimitations

The Study was delimited on the following aspects:

1. The study was delimited to the 200 meter and 400-meter sprinters who regularly practice at Sri Krishnadevaraya university, Anantapur.
2. Further the study was confined to those sprinters who participated at the Inter-Collegiate or Inter-University levels.
3. For measuring acceleration performance of the subjects, the distance was delimited to 40 meters and the third lane was used for this purpose.

Limitations:

1. Since only one runner was tested at a time the performance variation that might have occurred due to lack of competitions of the study.
2. The performance variations which might have resulted due to differences in the training experience of subjects was identified as another limitation of this study.

DEFINATION AND EXPLANATION OF THE TERMS

Positioning Angle

Fixation of the block at an angle with respect to the perpendicular to the starting line. For the purpose of the present study three variations (three degrees, six degrees and nine degrees) in block position were taken.

Spacing of Front Block

Distance of the front pedal Stopper) from the starting line. In this study three distance (12-inch 15- inch and 19- inch) were selected.

Acceleration Performance

Acceleration is defined as the rate at which the velocity changes with respect to time.

For the purpose of this study acceleration performance has been measured in terms of the time taken to complete a distance of 40 metres as quickly as possible for the crouch start.

Significance of the study

It is well known that in all the sprint events 'start' play an important role. Winning a race depends upon how much quicker and faster the athlete leaves the block. In the present competitive world even in 400 metre and 400 metre hurdles the difference between win and loss is mere on hundredth of a second. For evidence Indian ace Sprinter P.T. Usha lost a place in 400 metre hurdles by a margin of one hundredth of a second in 1984 Olympics held at Los Angles. There are so many instances like this in the field of Sprints.

Administration of the Test

Selection of the subject:

Procedure: Sixty male sprinters who trained for 200- and 400-meters sprints and who participated in Inter-Collegiate or Inter-University competitions between 2020 to 2024 of Sri Krishnadevaraya University, Anantapur, Andhra Pradesh selected as subjects for the purpose of the study. The age of the subjects raged between 18 to 24 years.

Positioning of the Blocks: To find out the better angle in the curve start we fix the block at 400 meters starting lane in the third lane. The distance of the front foot from the starting line were 12 inches, 15 inches and 19 inches from the starting line were selected to compare their effects on acceleration performance during the curve start.

A finish line was marked in third lane at 40 meters distance from the starting line of 400Meters starts. For the purpose of this study three variations in block spacing (three, six and nine degrees) and three variations in front block spacing (12, 15 and 19 inches) were investigated for their effects. Each subject was tested at each angle with three front block spacing's. Altogether each subject was tested under nine different starting position and combinations. To eliminate the systematic error the sequence of administration of various

combinations were assigned randomly (Latin square method). For this purpose, the subjects were divided into three groups (5 in each group) and tested in 3 sessions, 3 Starts during each session as follows.

	Session I	Session II	Session III
Group I	3” & 12”	3” & 15”	3” & 19”
	6” & 15”	6” & 19”	6” & 12”
	9” & 19”	9” & 12”	9” & 15”
Group II	3” & 15”	3” & 19”	3” & 12”
	6” & 19”	6” & 12”	6” & 15”
	9” & 12”	9” & 15”	9” & 19”
Group III	3” & 19”	3” & 12”	3” & 15”
	6” & 12”	6” & 15”	6” & 19”
	9” & 15”	9” & 19”	9” & 12”

The time taken by each subject between the starting line and the finish line was timed by three-time keepers by using one hundredth of a second electronic watch. The front stopper (Peddle) was placed at a distance of 32 inches (82 cm) from the inner lane to bring about uniformity while studying the effect of block positioning and front stopper spacing. To eliminate the reaction time was taken with the movement of the athlete to the 40 mts. The time was recorded to one hundredth of a second.

Statistical Technique for Analysis of the Data

The obtained data was statistically examined for significance of differences in acceleration performance due to variations in block position and variations in front block spacing from the starting line by Two-way Analysis of variance. Least significant difference method was utilized as a post-hoc comparison test to find out significance of difference between the paired means. To test the hypothesis .05 level of significance was considered as appropriate for this study.

Analysis of the Data

The analysis of the data[1]collected with regard to the study has been presented in this chapter. Two – way Analysis of Variance was employed to assess the differences in the effects of various combinations of crouch start on acceleration performance. For testing the obtained ‘F’ ratio, the level of significance chosen was .05 level, which was considered to be appropriate as the highly sophisticated instruments and equipment’s were used. When the ‘F’ ratio was found significant least significant difference method was applied as post-hoc test to assess the significance of differences between the paired means.

Result of the study

Two-way analysis of Variance for the date collected to study the effect of nine combinations of start on acceleration performance has been presented in Table-1.

TABLE – 1
TWO-WAY ANALYSIS OF VARIANCE FOR
THE DATA ON ACCELERATION
PERFORMANCES

Source of Variance	Df	SS	MSS	'F' Ratio	Table Value
Between Angle	2	0.340	0.17	5.38*	3.07
Between Block Spacing	2	0.238	0.119	3.77*	3.07
Interaction	4	0.030	0.0075	0.24	2.44
Residual	126	3.994	0.0316		

*Significant at .05 level.

It could be seen from Table 1 that the acceleration performance varied significantly due to the position of the block angle as the obtained 'F' ratio on 5.38 was higher than the table value of 3.07with 2 and 126 degrees of freedom at .05 level. Table 1 further indicates that the acceleration performance showed significant difference with different front block spacing as the obtained 'F' ratio of 3.77 among front block spacing was higher than the required F.05(2.126) = 3.07. It could also be seen from Table 1 that the interaction effect between positioning angle and front block spacing on acceleration performance was insignificant, since the obtained 'F' ratio of 0.24 for interaction was much less than the required 'F'.05(4.126) =2.44.

The above analysis of acceleration performance data, therefore, indicated that there was significant difference in acceleration performance due to the variations in positioning angle of the block. It further revealed that the front block spacing also had significant effect on acceleration performance. The results further indicated that there was no effect of positioning angle on front block spacing and vice versa. Since the 'F; ratio, for block position and front block spacing's was significant least significant difference Method was applied as post-hoc test to test the significance of differences; between the paired means of acceleration performance and no post-hoc test was applied for interaction, since it was found insignificant at .05 level.

Means mean differences and Least Significant Difference Method difference computed to study the effect of various positions of the block (three-, six- and nine-degree angles with respect to the perpendicular to the starting line) on acceleration performance have been presented in Table 2.

TABLEN- 2
MEANS, METHODS DIFFERENCES AND LEAST SIGNIFICANT DIFFERENCE METHOD DIFFEENCE FOR ACCELERATION PERFORMANCE DUE TO SELECTED POSITIONING ANGLES OF THE BLOCK

Means			Means differences	L.S.D.
3 Degree	6 Degree	9 Degree		
5.35	5.45		0.10*	0.07
5.35		5.47	0.12*	0.07
	5.45	5.47	0.02*	0.07

*Significant at .05 level.

Table 2 indicated that the mean differences in acceleration performance between three degree and six degree and three degrees and nine degrees were significant at .05 level as the mean difference values of 0.10 and 0.12 respectively were higher than the critical difference value of 0.07, Table 2 also indicated that there was no significant difference between six degrees and nine degrees position of the blocks on acceleration performance as their mean difference of 0.02 was less than the critical difference value of 0.07.

From the a above results, it could be observed that in acceleration performance the three-degree angle is significantly better than the six degree and nine-degree positioning angle of the block as the mean acceleration performance is less than the other two positions. It also indicates that there was no significant difference between six degree and nine-degree positioning angle.

The means of acceleration performance due to three-, six- and nine-degree positioning angles have depicted in Fig, 1.

Means, mean differences and least Significant Difference computed to study the effect of selected front block spacing's (12 inches, 15 inches and 19 inches from the starting line) on acceleration performance have been presented in table 3.

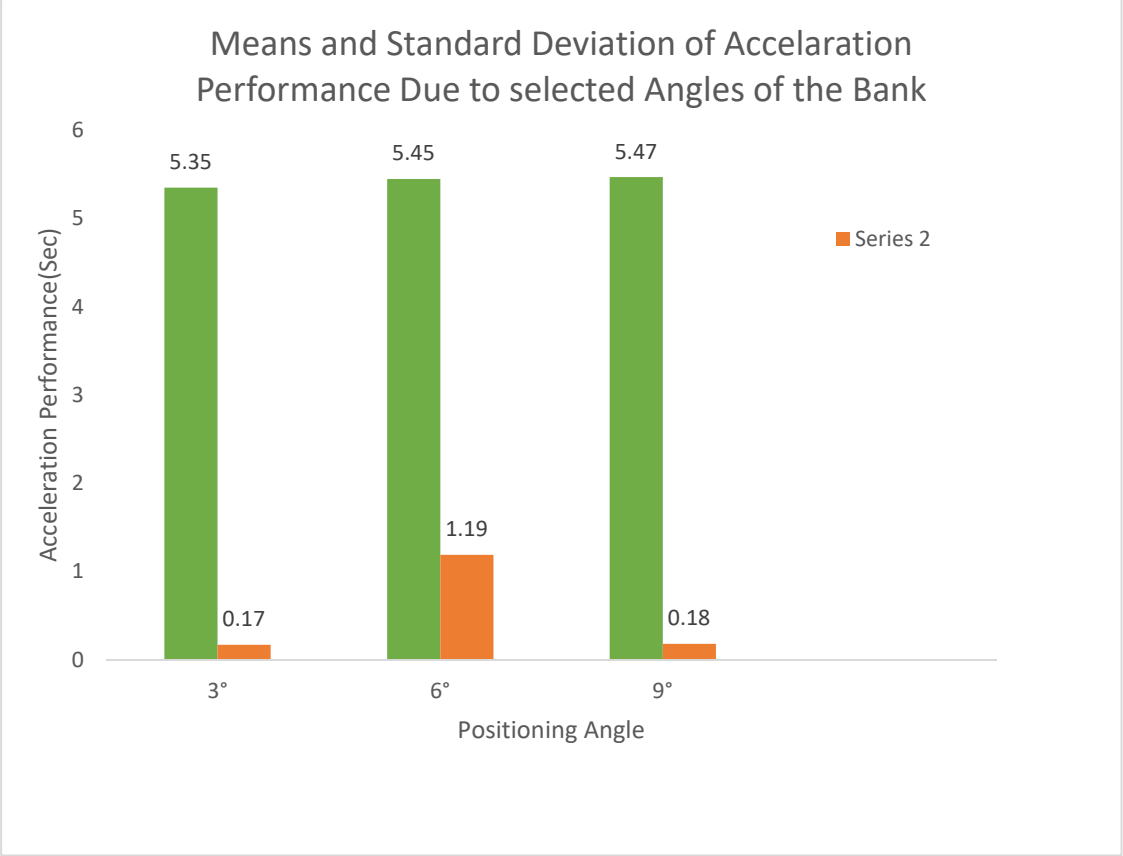


TABLE – 3
MEANS, MEAN DIFFERENCES AND LEAST SIGNIFICANT DIFFERENCE METHOD DIFFERENCE FOR ACCELERTION PERFORMANCE DUE TO SELECTED FRONT BLOCK SPACINGS

Means			Mean Differences	L.S.D.
12 INCHES	15 INCHES	19 INCHES		
5.46	5.37		0.09*	.07
5.46		5.45	0.01	.07
	5.37	5.45	0.08*	.07

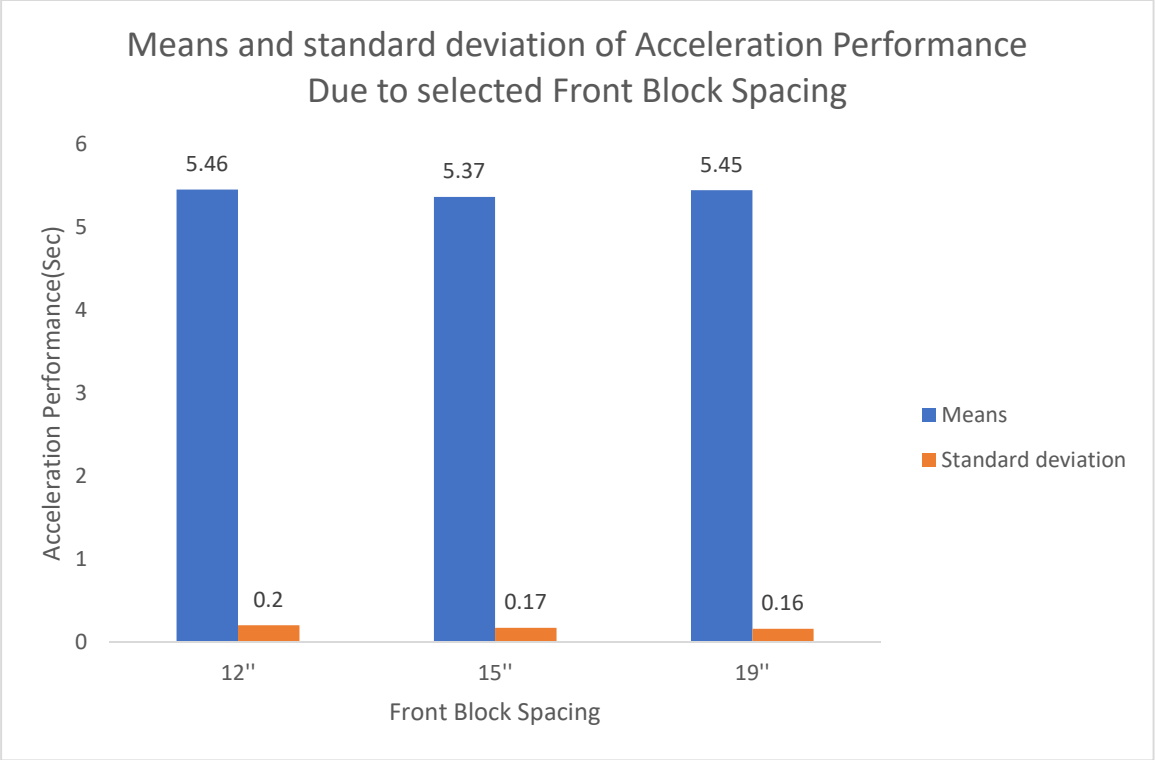
*Significant at .05 level.

From Table 3 it could be observed that the mean difference in acceleration performance between 12 inches and 15 inches, and 15 inches and 19 inches were significant at .05 level, as the mean difference values of 0.07. Table 3 also indicates that there was no significant difference between 12 inches and 19 inches block spacing on acceleration performance as the mean difference of 0.01 was less than the required Least Significant Differences Method difference value of 0.07.

The above result revealed that in acceleration performance 15 inches block spacing was significantly better than the 12 inches and 19 inches block spacing as the mean acceleration performance due to 15 inches block spacing was better than the 12 inches and 19 inches block spacing. The result further revealed that there was no significant difference between 12 inches and 19 inches block spacing on acceleration performance at .05 level.

The means of acceleration performance due to selected front block spacing's (12 in,15 in and 19 in,) have been depicted in Fig.2.

Figure 2: Means and Standard deviations of Acceleration performance Due to Selected Front Block Spacing.



Front Block Spacing

Discussion on Findings

Analysis of the data revealed that the variations in block position and the front block spacing had significantly (P .05) affected the acceleration performance. Among the three variations (3,6 and 9 degrees) in positioning angle of the block with respect to the perpendicular to the starting line, 3 degrees positioning angle was significantly (P .05) better than 6- and 9-degree positioning angle in its effected-on acceleration performance.

The acceleration performance depends upon proper utilization of the resultant reaction force, which an athlete acquired from the blocks. For this an athlete has to run in the direction of resultant reaction force in the initial stages of the race as the deviation or change in the direction in the initial stages results in loss of reaction force which causes loss in acceleration in the desired direction.

It could be further added that from the selected positioning angles of the block, (3,6 and 9) the extension of the block line of 6- and 9-degrees position are cutting the in line (20 cm away from the inner line)at 3.50 meter and 4.60 meter approximately, and from the 3 degrees positioning angles passing close to the inner line (20 cm away from inner line) at 5.40 meter without cutting it.

In case of 6 and 9 degrees position the athlete has to check his direction and run along with the curve in the initial stages itself which causes the loss in reaction force obtained from the blocks. In the case of 3 degrees position the athlete has an opportunity to run in the direction of the reaction force for longer distances and the change of direction is little towards inner line.

The analysis of the data also indicated that 15 inches front block spacing was significantly better ($P<.05$) than 12 inches and 19 inches front block spacing in their effects on acceleration performance. From the above result it could be interpreted that the 15 inches front block spacing is more comfortable to get maximum force from the block. The distance from starting line to front stopper is less in 12 inches front block spacing, and it may be too congested. In this start an athlete may start fast but he does not obtain maximum force from the block. Since there is no restriction in between block spacing, 19 inches block spacing also may be comfortable, but here the athlete is not taking full advantage of the start, i.e. he is starting from too far behind the starting line, this may be the cause for poor mean time for 19 inches front block spacing than 15 inches block spacing. This finding is in conformity with the findings of Sigerseth and Grinaker[2] and Dickinson[3].

Further the findings stated that there is no interaction between position of the block and front block spacing. This may be true because the variation in front block has no effect on the spot where the extension of the block line touches the inner line (20 cm away from the inner curve).

Discussion of Hypothesis

On the Basis of the findings of the study the hypothesis that the positioning angle and front block spacing would have significant effect acceleration performance is accepted.

Summary

The purpose of this study was to investigate the effect of positioning angle and front block spacing on acceleration performance during curve start.

For this purpose, 60- students from the Sri Krishnadevaraya University, Anantapur were taken as subjects. These subjects had participated at Inter-Collegiate or Inter-University level between the years 2019 to 2024, 200m or 400m.

The experimental variables for the present study were positioning angle the block (angle between perpendicular to the starting line and the mid line of the block) and front block spacing. Three variations (3,6 and 9 degrees) in positioning angle of the block were selected after conducting a pilot study, and three variations (12,15 and 19 inches) in front block spacing were selected on the basis of expert's opinion and the literature reviewed. The criterion measures of the study was acceleration performance, which was measured in terms of the time taken to sprint a distance of 40m, as quickly as possible.

The subjects (N=60) were tested under nine combinations (three variations in positioning the block and three variations in front block spacing). For eliminating the systematic error, the nine starting combinations were administered as per Latin Square Method. Before administration of the test the reliability of the data was established.

The data collected on acceleration performance with different combinations were compared and analysed by using Two-way Analysis of Variance. The obtained 'F' ratios were tested for significance at 0.05 level. When the, 'F' ratio was found significant Scheffe's test was applied as a Post hoc comparison test to find out the significance of differences between the paired means.

Analysis of the data revealed that there were significant differences at .05 level in the acceleration performance under different positions of the block (F= 5.43 against F.05= 3.07). The analysis also revealed that the acceleration performance significantly differed as the front block spacing varied (F=3.75 against F.05-3.07). Further it indicated that there was no interaction effect of position of the block and front block spacing (F=0.25 against F.05 = 2.44) on acceleration performance.

Post-hoc test revealed that the 3 degrees block position was significantly better than 6 degrees (Mean difference 0.093 against $1_{.05}$ = 0.074) and 9 degrees (mean difference 0.117 against Los=0.074) block position in its effect on acceleration performance. Among three variations

in front block spacing 15 in Spacing was significantly better than 12 in. (Mean difference. 095 against $l_{.05}$ = 0.074) and 19 in (Mean difference, 082 against $1_{.05}$ = 0.074) block spacing in its effect on acceleration performance.

Conclusions

Within the limitations identified and on the basis of the results of this study the following conclusions were drawn:

1. The subjects were significantly ($P < 0.05$) better in acceleration performance with 3 degrees block position as compared to 6- and 9-degrees block position.

2. 15 in. front block spacing was significantly ($P<0.05$) better than the other two block spacing (12and 19 in.) in its effect on acceleration performance.

Recommendations

Based on the conclusions of the study the following recommendations have been made.

1. For better acceleration during curve start a narrow positioning angle of the block with perpendicular to the starting line is recommended.

2. The front block may be fixed at a medium distance i.e. 15 inches from the starting line for better acceleration during curve start.

3. Same study may be repeated by employ a larger sample belonging to other achievement levels/ and sex.

4. Same study may be conducted for lanes other than the one used in this study to make better generalizations.

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