

Foot Placement by Elite Sprinters During Bend Running

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ABSTRACT

What is the most optimal positioning of the foot in sprinting? Toes forward, inward or outward? And what about sprinting on a bend, which forces the runner to contend with the task of maintaining high running velocity while counteracting the effects of centrifugal force. Altering foot placement can lead to noticeable changes in the interaction between the runner's musculoskeletal system and its underlying support (the ground) as well as in running efficiency. It is generally recommended that the foot should be placed with the toes turned slightly inwards on a bend. The author analysed the bend running efficiency of the finalists in the men's 200m at the 2009 IAAF World Championships in Athletics by comparing their time for the first 100m of the race with their yearly best performance over 100m and then examined television images of the race. He found that Usain Bolt, who set a world record of 19.19 sec in the race, was no better than 5th among the finalists for bend running efficiency, despite following the foot placement recommendation. Among the conclusions are that world-class sprinters position their feet differently when sprinting around bends and that many turn their toes outwards without visible loss of efficiency.

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Introduction

The characteristics of bodily movement after interaction between bodies are determined by the movement those bodies perform before interacting combined with the location of the force application points relative to the centre of mass in question. This highlights the importance of knowledge concerning foot placement in sprinting and the related basic kinematics, since altering foot placement can lead to noticeable changes in the interaction between the runner's musculoskeletal system and its underlying support as well as running efficiency in general.

However, most research into sprinting calls for considering the runner's musculoskeletal system along the sagittal plane (plane of movement), which prohibits proper analysis of complex foot movements along the frontal and transverse planes^{1,2}.

With that said, what is the most optimal way of positioning the foot while sprinting? Toes forward, inward or outward?

The aforementioned questions received preliminary answers in previous research dedicated to foot kinematics during sprinting³. However, the project only dealt with foot placement during linear sprinting.

Sprinting around a bend, as in the 200m, forces the runner to contend with the task of maintaining high running velocity and at the same time counteracting the effects of centrifugal force^{4,5}. It is clear that the solution to such a task lies at least partially with the body part in direct contact with the ground: the foot.

Research notes by NEMTSEV & CHECHIN⁶ point out that six sprinters approaching a bend turned their right (external) toes outwards rather than inwards as recommended by a number of authors^{7,8}, with the right (external) foot's angle being larger than that of the left (internal) foot. NEMTSEV & CHECHIN explained this by stating that turning their right toes outwards allows the runners to counteract centrifugal force. However, this research included athletes whose results were far from world-class and who had never been taught the specifics of turning the right toe inwards on bends. Another, earlier research project recorded the placement of the right foot in the same manner (toes pointed outward) while sprinting on a bend for a known elite runner: Olympic silver medallists Frankie Fredericks (NAM)⁹.

This shows the need for further research into foot placement during competitions with a large number of elite sprinters as a base in order to provide objective data that would help to answer the question of which technique is optimal when it comes to sprinting around a bend.

Methods

This project was based on video analysis of the men's 200m (semi-finals and finals) during the 2009 IAAF World Championship in Athletics in Berlin. The video material used was recorded from a television transmission and therefore it is not possible to provide any precise data due to lack of information regarding

the camera's positioning, recording speed and so on. However, the recording did give us the ability to find out how the runners placed their feet on the bends.

We also assessed sprinting efficiency in the bend by calculating the ratio of the time for the first 100m of the 200m, taken from the championship's website¹, to the athlete's 100m results. It was assumed that the lower the ratio, the higher the runners' efficiency in the bend. The 100m results taken into account were the athletes' best results for 2009², taken from the IAAF's season best list. No assessment was made for Charles Clark (USA) (best time 10.47 sec in 2005) and David Alerte (FRA) (best time 10.27 sec in 2007) as they are absent from the 100m list for 2009.

Results and Discussion

Table 1 shows the results of the men's 200m final at the 2009 IAAF World Championship in Athletics in Berlin.

Table 1: Results of the final of the men's 200m at the 2009 IAAF World Championships in Athletics

	Name	Time	Lane
1	Usain Bolt (JAM)	19.19	5
2	Alonso Edward (PAN)	19.81	6
3	Wallace Spearmon (USA)	19.85	4
4	Shawn Craford (USA)	19.89	8
5	Steve Mullings (JAM)	19.98	3
6	Charles Clark (USA)	20.39	7
7	Ramil Guliyev (AZE)	20.61	1
8	David Alerte (FRA)	20.68	2

In Figure 1, we see that the medallists Bolt, Spearmon and Edward positioned their feet differently in bend. Bolt turns his right toe slightly inward while Spearmon and Edward position their right feet with toes turned outward.

The shots of foot placement for the other finalists were of lower quality due to different camera angles so images from their semi-finals were used (Figure 2). However, regardless of

Table 2: Sprinting efficiency in the bend for selected finalists in the 200m at the 2009 IAAF World Championships in Athletics (ranked by efficiency)

Rank	Name	100m Bend	100m 2009 Best	<u>100m Bend</u> 100m 2009 Best
		[sec]	[sec]	[sec]
1	Crawford (USA)	10.15	10.21	0.994
2	Mullings (JAM)	10.20	10.01	1.019
3	Spearmon (USA)	10.42	10.18	1.024
4	Edward (PAN)	10.37	10.09	1.028
5	Bolt (JAM)	9.92	9.58	1.035
6	Guliyev (AZE)	10.77	10.08	1.068

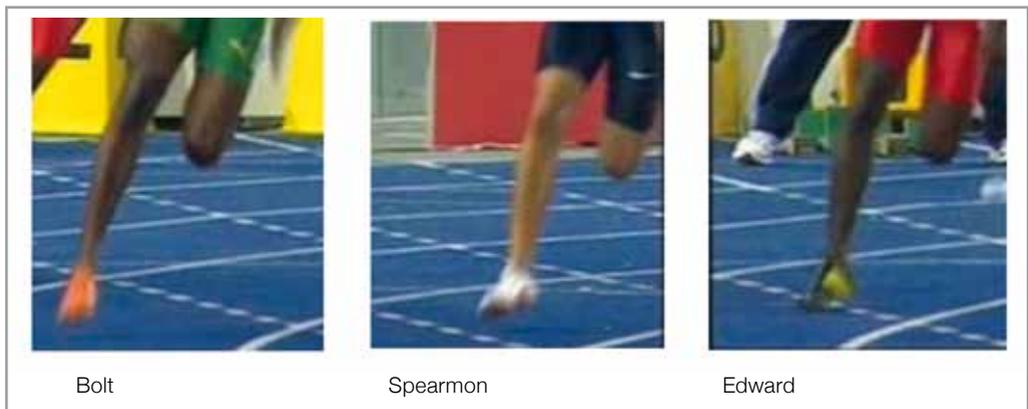


Figure 1: Right foot placement on the bend in the 200m final at the 2009 IAAF World Championships in Athletics for Usain Bolt (JAM), Wallace Spearmon (USA) and Alonso Edward (PAN).



Figure 2: Right foot placement on the bend in the semi-finals at the 2009 IAAF World Championships in Athletics for Steve Mullings (JAM), Charles Clark (USA), David Alerte (FRA), Ramil Guliyev (AZE) and Shaun Crawford (USA)

quality, the images provide enough evidence to conclude that Steve Mullings positions his right foot with the toes inward (just like Bolt) while the rest of the finalists turn their toes outward.

This leads an interesting observation. Bolt, despite incredible world records in both for the 100m and 200m in Berlin, ranks only fifth out of six in terms of sprinting efficiency on the bend (Table 2). This is despite the fact that he followed the generally accepted coaching ad-

vice to turn the toes slightly inwards when running around a bend. Of course, it is possible that Bolt's or any other sprinter's time for the first half of the 200m reflects tactics as much as or more than the foot-placement technique.

Conclusions

- 1) The materials used in this research show that, in contrast to the general advice given by many authors, many world-class sprinters position their feet with toes outwards on the bends without any visible loss of efficiency.
- 2) The lack of sufficient television coverage from the World Championship television recordings gives reason to organise a specialised research project to better understand elite sprinters' foot placement during bend running.
- 3) It would be more correct to compare the time for the 100m on the bend gathered from 200m with 100m results from the same competition rather than separate ones.

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