DYNAMICAL EFFECTS OF SPRINT START ON DIFFERENT STARTING BLOCKS

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The purpose of this study was to examine the dynamical variables of sprint start in two different starting blocks setups. The ReacTime Personal Systems was used to record the Reaction Time (RT) and the Power of 20 teenaged sprinters (15 males and 5 females) in the sprint start. In addition, the Newtest Powertimer photocells were used to collect subjects' 0 to 10 metre (T10) performance after the sprint start. The variables were tested by the repeated measures one-way ANOVA by SPSS 19.0 statistical software at a .05 significant level. The results showed that there were better effects on the short starting block (SB) in power generation performance than the long starting block (LB). The athletes can apply short starting block and make adjustments and modifications based on their training conditions.

KEY WORDS: biomechanics, reaction time, short, long, starting block.

INTRODUCTION: According to IAAF rules 161 and 162, contestants must use starting blocks provided by the authority. Ever since the invention of starting blocks in 1927, sprint start has been the focus for athletes and coaches in track-and-field training. In sprint events, especially 100 metre sprint race, a good sprint start becomes a crucial factor for a sprinter to win the race. In track-and-field sprint events, sprinters start the game by adjusting their starting block mode. Therefore, the adjustments of the starting block mode are very important for sprinters.

In terms of the placement of the starting block, according to Harland & Steele (1997), the bunch start has the quickest RT but as the body COM is closer to the starting line, there will be larger load on the hands. The medium start is the best for the general sprinters while the elongated start has the largest power but relatively longer supporting time on the block. Past research (Yu, 2006) suggested that the teenagers should start with elongated start during push-off starting block pad, then with training and experiment to find their optimum position.

As for the angle of sprint start, most studies focused on the relationship between the knee joint angle of the front leg and of the back leg during the set stage. Mero's analyses of elite sprinters and non-elite sprinters showed that there were no significant differences between the angles of the knee joints during the set stage (1983). In Mero's research (1988), he pointed out that in the set stage, the knee joint angle of the front leg was approximately at 96 degrees and the rear was about 126 degrees.

At the stage of taking off, athletes' reaction time and acceleration play crucial parts in starting techniques. In terms of reaction time, it is against the regulation in track and field if the reaction time is less than 0.1 second. Other researches found that in all sprint events, the reaction time of the best athletes is shorter than 200 ms (Dostal, 1981; Mero & Artman, 1984; Moravec, Ruzicka, Susanka, Dostal, Kodejs, & Nosek, 1988). Moreover, the reaction time does not correlate with the performance levels. Therefore, it is very indispensible to improve athletes' reaction time within the regulation.

After all, a good start should be a good thing for the 100 dash. Start-acceleration is the stage right after athletes leave the starting blocks. The acceleration in the first 10m will directly influence the results. In the study of Slawinski, et al. (2010), it was found that the 10m performance of six well-trained sprinters (1.88±0.03 seconds, reaction time included) and six elite sprinters (1.97±0.05 seconds, reaction time included) are less than 2 seconds. Table 1 is the reaction time and 0-10m performance of world-record keepers, which is used as a reference of this study.

Both sprint races and the training of taking off begin with the adjustments of the starting blocks. Thus, the use of the starting blocks is very important for sprinters. As the design of starting block becomes more diversified with different height for pedals, the correlation and the causality needs to be further discussed. The present study was the analyses of two different starting blocks, NISHI (JAPAN) long starting block and JEX (TAIWAN) short starting block. Moreover, the aim of the study was to investigate whether using different types of starting blocks would affect the 10m sprint time, reaction time and power of the sprint start.

Table 1: 100m World record 10m splits

	Ben Johnson 1988	Carl Lewis 1988	Maurice Green 1999	Maurice Green 2001	Tim Montgomery 2002	Asafa Powell 2005	Usain Bolt 2008
RT (s)	0.132	0.136	0.162	0.132	0.104	0.150	0.165
0-10m (s)	1.83	1.89	1.86	1.83	1.89	1.89	1.85

GuamBomb (2009)

METHODS: In this study, 20 subjects had received sprint training in track and field for more than three years. Their ages, heights, weights, and best performances in 100-m are presented in Table 2. The subjects of this study were 15 male teenage sprinters and five female teenage sprinters. The subjects were counterbalanced-arranged and were asked to apply NISHI (JAPAN) long starting block (LB) and JEX (TAIWAN) short starting block (SB) twice respectively. Each subject was required to run 10 metre at maximum speed and their best performances were selected for analyses. To ensure the accuracy of the data and reduce experimental errors, each subject used their usual start mode (including block position and the angle of the block) and was trained to use two starting blocks for one month. The reaction time (RT) refers to the time when sprinters response to the start signal and begin to leave the starting blocks. And Power (Work/Time) refers to the peak work sprinters generation during the push-off stage. It was measured with ReacTime Personal Time Training Systems (USA). The time at 0 to 10m (T10) refers to the time between 0 to 10m deducting sprinters' reaction time. It was recorded by using Newtest Powertimer photocells (Finland). All data are presented as means plus or minus SD. All data using repeated measures One-way ANOVA. The variables were tested by SPSS 19.0 statistical software at a .05 significant level.

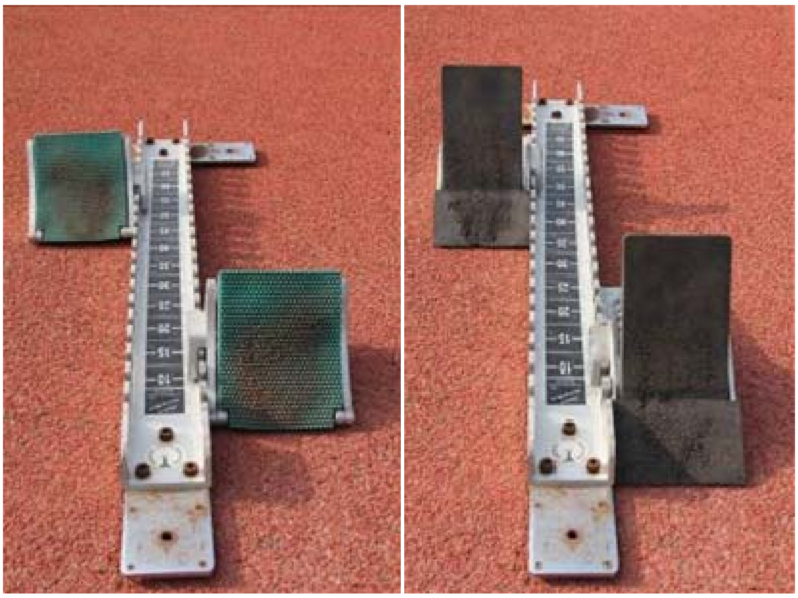

Figure 1: The two Blocks JEX (Taiwan, Short) and NISHI (Japan, Long).

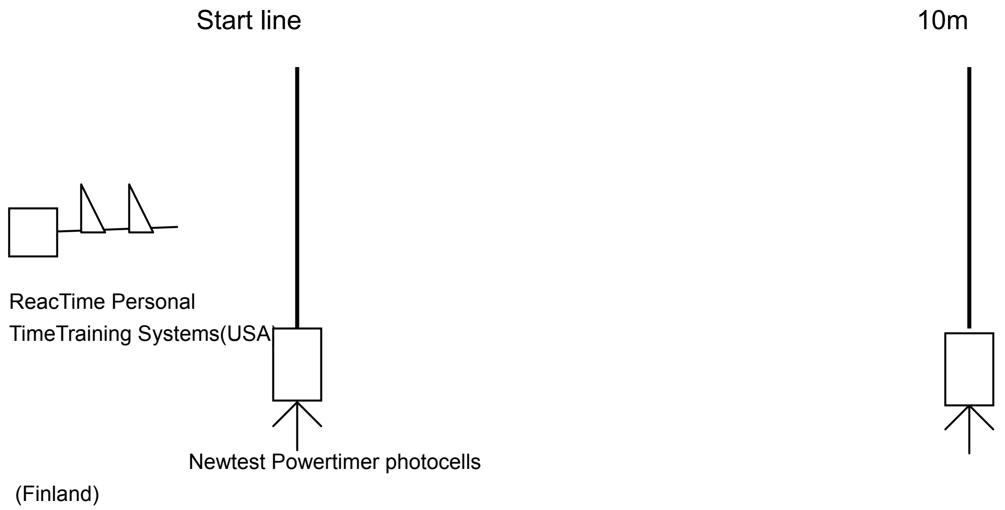

Figure 2: The experimental setup of the 10 meter sprint start.

Table 2: Characteristics of sprinters.

Variable	Height(m)	Weight(kg)	Age(yr)	100-m time(s)
n=20	1.718±6.23	62.67 ±5.59	17.0 ±0.86	11.95 ±0.77

Table 3: The comparison between SB and LB in RT+T10, RT, T10 and power parameters.

Variables	Blocks	Mean ±SD	F
RT+T10 (s)	SB ±SD	2.07 ±0.23	1.816
	LB ±SD	2.21 ±0.21	
RT (s)	SB ±SD	0.298 ±0.154	1.083
	LB ±SD	0.333 ±0.151	
T10 (s)	SB ±SD	1.78 ±0.08	1.654
	LB ±SD	1.79 ±0.08	
Power (w)	SB ±SD	3983 ±1045	13.769*
	LB ±SD	2789 ±1271	

*p<0 .05

RESULTS: The descriptive statistics of the reaction time plus 0-10 m performance time (RT+T10), the reaction time (RT), the running duration time of 10 metres (T10) and the power are presented in table 3. In terms of RT+T10, the sprinters using short starting block (SB) performed 2.07 ±0.23 s and RT+T10 of long starting block (LB) was 2.21 ±0.21 s. In terms of RT, the sprinters using short starting block (SB) performed 0.298 ±0.154 s and reaction time of long starting block (LB) was 0.333 ±0.151 s. As for T10, subjects performed 1.78 ±0.08 s when using SB and 1.79 ±0.08 seconds for using LB. In terms of Power, subjects using SB generated 3983 ±1045 watts and using LB was 2789 ±1271 watts. There was significant difference in power between the SB and LB sprint starts.

DISCUSSION: Slawinski, et al. (2010) found that the 10m performance time of six well-trained sprinters and six elite sprinters was separately 1.88±0.03 seconds and 1.97±0.05 seconds (Reaction time included). Compared the result to this study, it was found that the 10m performance time of teenage athletes using SB was faster than using LB although there is non-significant difference. It may be that the teenage athletes can adopt SB to have better 10m performance.
Regarding the reaction time, according to Dostal (1981), Mero & Artman (1984), and Moravec et al. (1988), they found that in all sprint events, the reaction time of the best athletes was less than 200msec. However, the reaction time of the two starting blocks in this study was more than 200msec. It can be inferred that as the participants in this study performed varieties in the reaction time they should be trained to shorten their reaction time to have better performances. Furthermore, concerning T10 (Reaction time deducted), teenage athletes' 10m performance time is this study was 1.78±0.08 seconds (SB) and 1.79±0.08 seconds (LB), there was no significant difference between the SB and LB. Therefore, it can be inferred that teenage athletes should improve their reaction time training.
In the push-off stage of sprint start, the power athletes generate from the starting block was an indispensable technique (Hsu, 1996). On the starting period, athletes generate the reaction force from horizontally pushing off the starting block, which accelerates their bodies forward. Short reaction time and the power legs produce from starting blocks are the key factors for a quick sprint start. In this study, the results have revealed that teenage athletes generated more power when using SB as compared to using LB. Therefore, when teenage athletes train for sprint starts, they should make more use of short starting blocks. Moreover, they should take advantage of stretch-shortening cycle training to enhance the power of the legs. Accordingly, athletes can exert the power which generates from the starting block effectively make a prompt sprint start.

CONCLUSIONS: The sprint start is a very important technique in track and field short distance sprint. The positioning of the starting block and the adjustments of blocks angles are crucial factors which influence the sprint start. In sprint races, athletes prepare before the start by adjusing the starting block in order to have the best result. A good start mode can assist athletes to gain faster time whereas a bad start may have opposite effects. This study intended to explore the effects of blocks heights of two different starting blocks on teenage sprinters' sprint starts. Results indicated that short starting block had better effects on athletes' Power than the long starting blocks. In terms of variables, subjects using short starting blocks demonstrated significantly more Power as compared to subjects using long starting block. Thus, when coaches and athletes train for sprint start, they can implement short starting blocks and make adjustments and modifications accordingly. In this way, they are surely to find the most suitable mode for each runner, which leads the runner to their best record.

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