POWER AND VELOCITY OUTPUTS IN POINTS RACE

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The objective of this study was to investigate the power and velocity changes during sprinting in a points race. The points race is a 30 km track competition. The final placings are determined according to distance covered and points won by riders. The SRM system was installed onto the cyclists' bike and the power output and the velocity were recorded in three Cycling World Cup Championships. 77 representative sprints were selected in the races to calculate power and velocity in each sprint. The findings showed that a points race cyclist should employ a drafting strategy wisely to save the energy until a proper moment in the point laps. Also, the time lag between maximum power and maximum velocity could give cyclists an idea on the best timing to start the sprint in points race.

KEY WORDS: cycling, points race, SRM, sprint

INTRODUCTION: The points race is an event in track cycling in which a group of cyclists compete with each other in a velodrome for 90 laps. The points race is a speciality in which the final placings are determined according to distance covered and points won by riders during the intermediate and final sprints. To be the champion of the race, the cyclist must fulfil either of the following conditions. First, the cyclist leads the main group for one or more laps. Second, the highest total point obtained at the end of race. There will be a point lap in every 10 laps in the 333 m track. The first rider in each intermediate sprint will be awarded five points, the second three points, the third two points and the fourth one point. Points awarded for the final sprint will be doubled. Competitors sprint at top speed in each point lap in order to get points to win the race. Some of the competitors try to surpass the main group one or more laps at any time. The strategy of points race is complex and highly dependent on the competitor himself. A better understanding of a points race may benefit the cyclists to implement a suitable strategy to fight for the best position during the point laps or to surpass the main group at best opportunity. The objectives of this study were to determine the power and velocity changes during sprinting in a points race and to compare with the performance of another 4 km individual pursuit.

METHODS: The participant in this study was a 27 year old elite male cyclist (height = 1.72 m, mass = 61 kg). He was one of the qualifiers in 2000 Olympic Games in the points race event and gold medallist in the Asian Games in 1998 and Asian cycling championship in 1999. The SRM (Schroberer rad MeBtechnik, Weldorf, Germany) system was installed onto the bike to record the power output and velocity during the 30 km points races in the 2000 World Cup Cycling series competitions at Moscow, Cali and Kuala Lumpur. These three races were all held on a 333 m long wood track. The SRM system recorded the power output and velocity simultaneously. 77 representative sprints were selected from three different races. For each individual sprint, the following parameters were used to describe the characteristics of performance of the cyclist: PC was the power increase from the beginning of the sprint to maximum power. VC was the velocity increased from beginning of sprint to maximum velocity. TC was the time lag between maximum power and maximum velocity. Pmax was the maximum power output. Vmax was the maximum velocity. T1 was the time period required for the cyclist to increase the power from beginning of sprint to maximum. T2 was the time period required for the cyclist to increase the velocity from beginning of sprint to maximum. Also, the data were compared with another 4 km individual pursuit race in the World Cup Cycling competition in Moscow.

RESULTS AND DISCUSSION: There was a total of 77 representative sprints in three different races. On average, there were more than 25 sprints in each race. This equates to a sprint every 1.2 km on average.

Power and velocity in different races: From Table 1, although the bike velocity was high, the power output was small in the Moscow race. On the other hand, the power output was large with low bike velocity in Kuala Lumpur race. This was because the cyclist had more chance of drafting other cyclists in the Moscow race, as there were more participants. Besides that, the cyclist could draft in third and fourth positions behind the leading cyclists in the Moscow race. In this case, the cyclist could save more energy. The power consumption of a drafting cyclist is approximately 70% of the leading cyclist (Broker, Kyle & Burke, 1999). The average power output in Moscow race was 69.6% that of average power in Kuala Lumpur race, which is consistent with Broker et al.'s findings. A points race cyclist should employ a drafting strategy wisely to save the energy until an appropriate time in the point laps. The average power consumption and the average velocity of the cyclist were 301.9 W and 48.8 $km \cdot h^{-1}$ in the 4 km individual pursuit race. These data were similar to the average power and the average velocity of the points races in Cali and Kuala Lumpur. Both the points race and the 4 km individual pursuit were high intensity events.

Table 1 Average Power Output, and Average Velocity in Three Different Races

	Average power (W)	Average velocity ($km \cdot h^{-1}$)	Number of participants	Position achieved
Moscow	189	52.1	52	5
Cali	291	49.5	Approx. 23	9
Kuala Lumpur	271	47.8	Approx. 21	11

Increase of power and velocity in sprint: The average power and velocity increase in 77 sprints were 633 W and 11.3 $km \cdot h^{-1}$ respectively. There were nine out of 77 sprints for which power exceeded 900 W. The PC for the 4 km individual pursuit race was 925 W. Moreover, the average Pmax was 691 W and, in five out of 77 sprints, was greater than 1 kW. The average rate of power increased (PC/T1) for 77 sprints was 103.2 $W \cdot s^{-1}$ which was quite close to the rate of power increased from the beginning to maximum power in the 4 km individual pursuit (108.8 $W \cdot s^{-1}$). The points race involved repeated high intensity sprints. The correlation coefficients between PC and VC, and Pmax and Vmax were $r = 0.417$, ($p < 0.01$) and $r = 0.402$, ($p < 0.01$), which are classed as moderate. According to the equation *power = force × velocity*, the velocity should positively correlated with power if the force is kept constant. However, points races involve a lot of drafting strategies by non-leading cyclists, including drafting and leading in a small group from time to time. This would make the force term vary. For the leading cyclist, the resistive force was rather constant compared with cyclist riding behind.

Time lag between maximum power and maximum velocity: The power was reached its maximum prior to maximum velocity. The average value of TC was 4.18 ± 2.66 s. This implied the cyclist should draft behind other cyclists at an advantageous position to conserve energy until 4 seconds before the point where marks could be awarded. The correlation coefficients between TC and T2, and T1 and T2 were found to be $r = 0.680$ ($p < 0.01$) and $r = 0.762$ ($p < 0.01$) respectively. There was no significant correlation between variable TC versus PC and T1 versus PC, but a significant correlation was found between TC and VC. When the cyclist was in the drafting position, TC and T2 were small and power was high. When the cyclist was in the leading position, TC and T2 were large. At the same time, PC increased with small VC ($r = 0.245$, $p < 0.05$). As such, the TC value could give cyclists an idea on the best timing to start the sprint in points race.

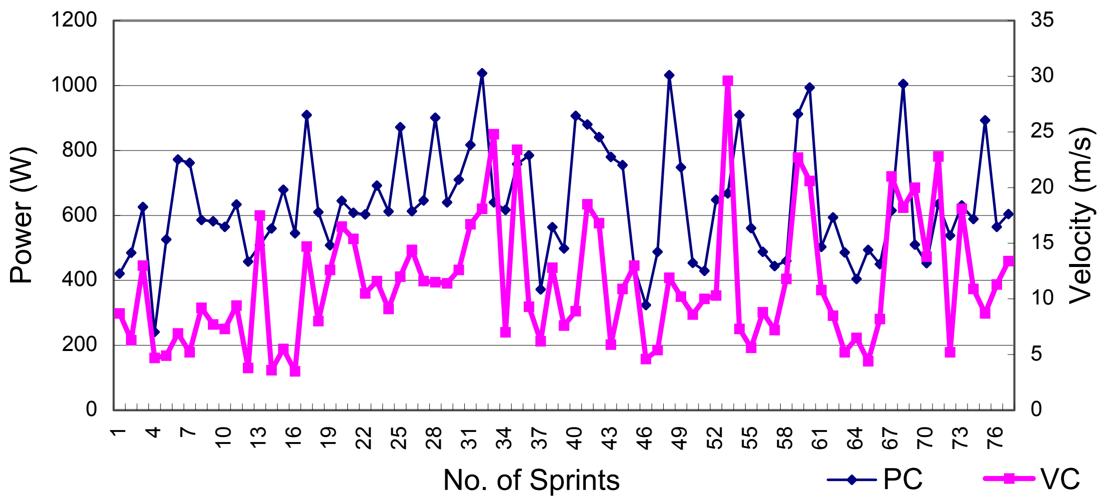

Figure 1 - The power and velocity change in different trials.

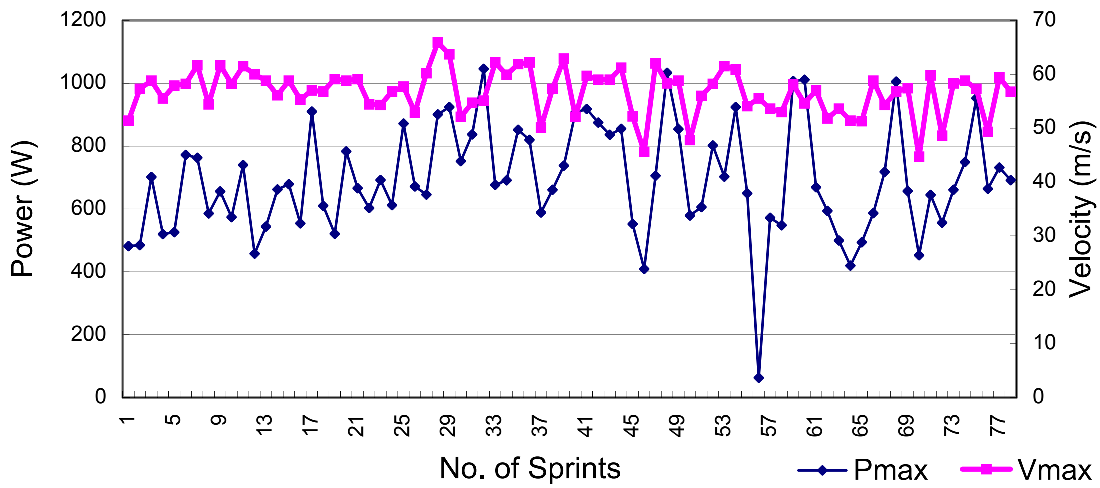

Figure 2 - The maximum power and maximum velocity in different trials.

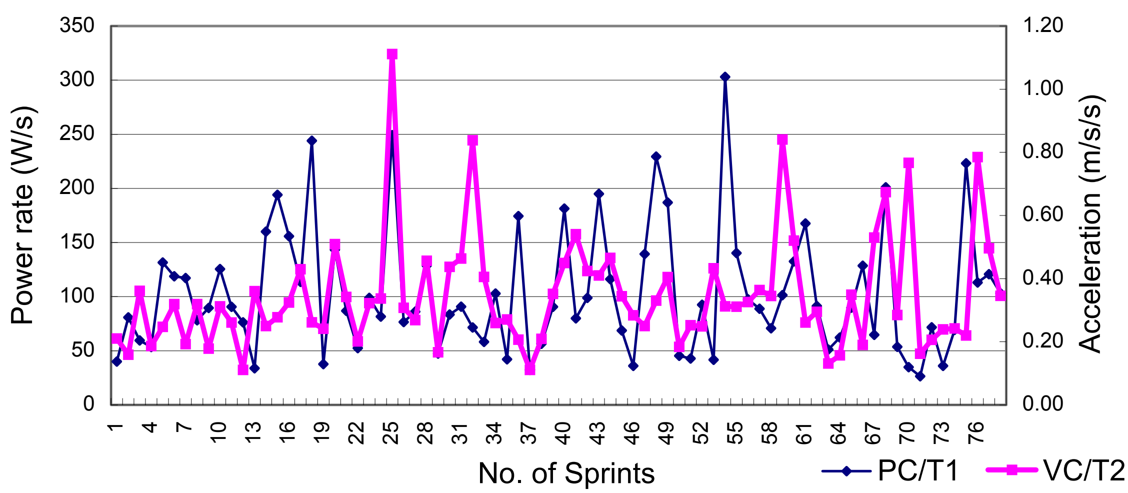

Figure 3 - The rate of power change and velocity change in different trials.

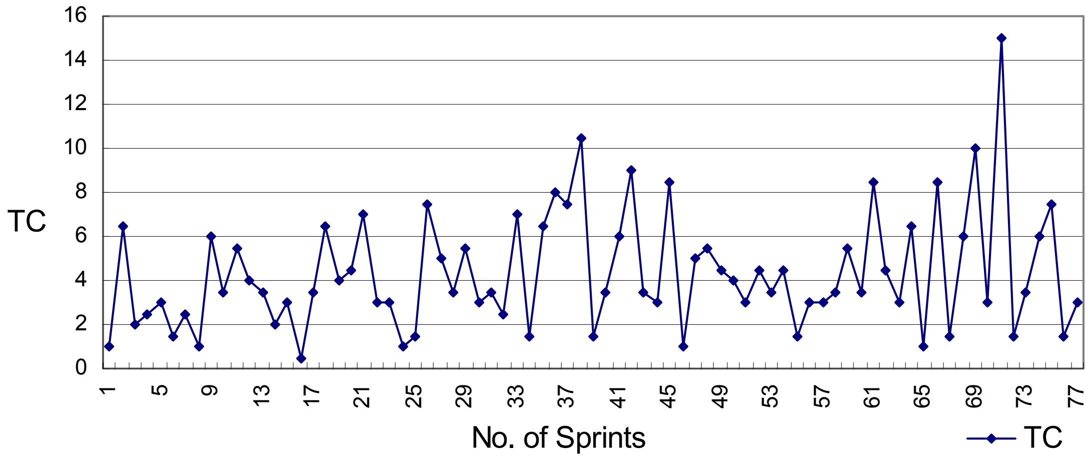

Figure 4 Time lag between maximum power and maximum velocity in different trials.

CONCLUSIONS: The points race is a complicated event and requires tactics throughout the race. Participants are required to cycle at high speed, sprint and overtake in order to gain points to win the race. From a sample of 77 sprints, 10% reached the intensity close to the rate of power increase from the beginning to maximum power in 4 km individual pursuit. Non-leading cyclists in points races utilise strategies such as drafting and leading in a small group from time to time. As there was a time lag between maximum power and maximum velocity, cyclists should start the sprint a few seconds ahead so that maximise speed happened at the desire position.

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