Has the new false start rule affected the reaction time of elite sprinters?
By Massimiliano Ditroilo, Andrew Kilding

Reaction time (RT) is considered an important determinant of success in sprint events. Indeed, a good start can make the difference between winning a gold medal and losing one! In the attempt to get out of the blocks as fast as possible, athletes try to react quickly to the start signal. However, during competitive races, anticipation of the starter’s gun may result in a false start. Until the end of 2002 every athlete was allowed one false start before being excluded on their second offence. However, since the beginning of 2003, only one false start per race is allowed. Any athlete making a further false start in that race is disqualified.

The aim of this study was to determine if the new rule has influenced the RTs of world-class athletes. More specifically, are athletes more cautious because there is a greater risk of disqualification? Essentially, this would be supported if consistent differences were apparent in the RT of high level athletes when competing under the old rule (OR) and under the new rule (NR). The performance times (PT) and RT of 100m sprinters and 110m and 100m hurdlers competing in two IAAF World Championships in Athletics were analysed: Edmonton 2001 (OR) and Paris 2003 (NR). Overall, it was found that RT was not significantly different in athletes competing in Edmonton and in Paris although hurdlers had, on average, slower RTs in Paris (NR) compared to Edmonton (OR).
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Introduction

Reaction time (RT) in sprint events, the duration of the period between firing the starting pistol and the first observable movement of the athlete, has been identified as one determinant of success in sprinting. However, the acceleration distance, the maximum speed attained and the speed-endurance of the athlete\textsuperscript{1,2} are the most important factors. The relationship between RT and performance time (PT) is controversial but the shorter the race, the more important the RT is for the final PT\textsuperscript{1,2,3}.

Usually, sprinters dedicate some of their training time to practice aimed at improving their reaction to a starting signal. Indeed, studies have been conducted to investigate if it is possible to improve RT, either by training the attention to the starting signal or to the motor response\textsuperscript{4,5}. Paying attention to the motor response was found to be most beneficial for improving RT\textsuperscript{4,5}.

All sprinters, when they are in the “set” position, aim to push-off, away from the starting blocks, as fast as possible immediately after hearing the starting gun. In an attempt to reduce the latency period, there is a tendency for athletes to push-off at the same time as they hear the signal\textsuperscript{6}. As a result, athletes sometimes anticipate the starter’s signal and commit a false start. If the RT is under 100 milliseconds\textsuperscript{7}, the athlete is deemed to have “jumped the gun”. Therefore, the main task of the judge, aided by technical apparatus, is to identify if any athlete(s) has indeed moved before the gun. Unfortunately, on some occasions, decisions have caused disagreement between athletes and officials.

The old rule (OR) on false starts allowed every athlete competing in a race to commit one false start before disqualification. In an attempt to “improve the image of the sport on television and to make sure schedules run to time”, a new rule (NR) was agreed at the Congress of the International Association of Athletics Federations (IAAF) during the 2001 IAAF World Championships in Athletics held in Edmonton. This rule states that “only one false start per race shall be allowed” (excluding combined events). “Any athlete(s) making further false starts in the race shall be disqualified from the race”. Among athletes and coaches, there appears to be mixed opinion (positive and negative) on the NR. Since the NR was introduced at the beginning of 2003, several disqualifications have been given in major competitions.

The new rule may have increased the probability of disqualification but has the NR influenced athletes’ RT at the start? More specifically, are athletes more cautious given the potentially greater risk of disqualification? The aim of this study was to investigate whether the NR has slowed the RT of elite sprinters during World Championship races.

Methods

The results of the IAAF World Championships in Athletics held in Edmonton 2001 and Paris 2003 were collected and analysed\textsuperscript{8,9}. Specifically, the RTs and PTs of 100 metres (men and women), 110 metres hurdles (men) and 100 metres hurdles (women) were examined.

The mean (±SD) RT and PT performances from the two championships were compared. Anomalously slow performances were ignored such that for the mens’ 100m, PTs under 12.0sec in the heats and under 11.0sec in the other rounds were considered. For the womens’ 100m, PTs under 14.0sec in the heats and under 13.0sec in the other rounds were considered. Performances under 15.0sec were considered for both mens’ 110m hurdles and womens’ 100m hurdles.

The PTs and RTs of those athletes who competed both in Paris and in Edmonton were also compared. The average PT and RT gained in the heats, quarter-finals and semi-finals for 100m men were compared for each athlete. For 100m women, the average PTs and RTs from the heats and quarter-final were considered and for 100m and 110m hurdles,
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### Table 1: Performance times (PT) and reaction times (RT) for the mens' 100 metres. Values are mean ± SD.

<table>
<thead>
<tr>
<th>Round</th>
<th>N</th>
<th>Edmonton 2001 PT (s) / RT (s)</th>
<th>Paris 2003 PT (s) / RT (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heats</td>
<td>74</td>
<td>10.61 ± 0.38 / 0.167 ± 0.021</td>
<td>10.58 ± 0.47 / 0.156 ± 0.019</td>
</tr>
<tr>
<td>Quarters</td>
<td>38</td>
<td>10.81 ± 0.15 / 0.160 ± 0.012</td>
<td>10.19 ± 0.11 / 0.154 ± 0.020</td>
</tr>
<tr>
<td>Semi</td>
<td>15</td>
<td>10.21 ± 0.13 / 0.144 ± 0.013</td>
<td>10.23 ± 0.13 / 0.167 ± 0.031</td>
</tr>
<tr>
<td>Final</td>
<td>8</td>
<td>10.00 ± 0.14 / 0.149 ± 0.010</td>
<td>10.12 ± 0.06 / 0.141 ± 0.015</td>
</tr>
</tbody>
</table>

### Table 2: Performance times (PT) and reaction times (RT) for the womens' 100 metres. Values are mean ± SD.

<table>
<thead>
<tr>
<th>Round</th>
<th>N</th>
<th>Edmonton 2001 PT (s) / RT (s)</th>
<th>Paris 2003 PT (s) / RT (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heats</td>
<td>54</td>
<td>11.86 ± 0.78 / 0.177 ± 0.044</td>
<td>11.97 ± 0.82 / 0.172 ± 0.031</td>
</tr>
<tr>
<td>Quarters</td>
<td>31</td>
<td>11.34 ± 0.19 / 0.145 ± 0.016</td>
<td>11.30 ± 0.19 / 0.159 ± 0.016</td>
</tr>
<tr>
<td>Semi</td>
<td>16</td>
<td>11.22 ± 0.17 / 0.146 ± 0.017</td>
<td>11.17 ± 0.14 / 0.150 ± 0.022</td>
</tr>
<tr>
<td>Final</td>
<td>8</td>
<td>11.01 ± 0.14 / 0.149 ± 0.019</td>
<td>11.00 ± 0.08 / 0.171 ± 0.031</td>
</tr>
</tbody>
</table>

### Table 3: Performance times (PT) and reaction times (RT) for the mens' 110 metres hurdles. Values are mean ± SD.

<table>
<thead>
<tr>
<th>Round</th>
<th>N</th>
<th>Edmonton 2001 PT (s) / RT (s)</th>
<th>Paris 2003 PT (s) / RT (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heats</td>
<td>37</td>
<td>13.68 ± 0.14 / 0.143 ± 0.016</td>
<td>13.61 ± 0.19 / 0.174 ± 0.039</td>
</tr>
<tr>
<td>Semi</td>
<td>22</td>
<td>13.52 ± 0.20 / 0.146 ± 0.014</td>
<td>13.62 ± 0.19 / 0.175 ± 0.036</td>
</tr>
<tr>
<td>Final</td>
<td>8</td>
<td>13.41 ± 0.30 / 0.143 ± 0.011</td>
<td>13.36 ± 0.17 / 0.151 ± 0.006</td>
</tr>
</tbody>
</table>

### Table 4: Performance times (PT) and reaction times (RT) for the womens' 100 metres hurdles. Values are mean ± SD.

<table>
<thead>
<tr>
<th>Round</th>
<th>N</th>
<th>Edmonton 2001 PT (s) / RT (s)</th>
<th>Paris 2003 PT (s) / RT (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heats</td>
<td>29</td>
<td>13.06 ± 0.27 / 0.151 ± 0.020</td>
<td>13.15 ± 0.33 / 0.168 ± 0.036</td>
</tr>
<tr>
<td>Semi</td>
<td>14</td>
<td>12.81 ± 0.16 / 0.140 ± 0.016</td>
<td>12.95 ± 0.19 / 0.159 ± 0.025</td>
</tr>
<tr>
<td>Final</td>
<td>8</td>
<td>12.67 ± 0.19 / 0.145 ± 0.022</td>
<td>12.73 ± 0.12 / 0.155 ± 0.008</td>
</tr>
</tbody>
</table>
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the PTs and RTs gained in the heats and semi-finals were considered.

All statistical analyses were conducted using SPSS (release 10.1, SPSS, Chicago, IL). PT and RT are presented as mean (± SD) values. Data were compared using paired t-tests (comparison of every athlete's performance and reaction time achieved in Edmonton and in Paris). Prior to statistical comparison, the data were checked for normality using the Kolmogorov-Smirnov test. Statistical significance was set at P < 0.05.

Figure 1: Reaction time (mean ± SD) registered in different rounds of the mens’ 100 metres in Edmonton 2001 and Paris 2003

Figure 2: Reaction time (mean ± SD) registered in different rounds of the womens’ 100 metres in Edmonton 2001 and Paris 2003
Results

Tables 1 and 2 show the mean (± SD) PTs and RTs for 100m (men and women respectively), in Edmonton and Paris. Similarly, Tables 3 and 4 show the same data for 110m hurdles and 100m hurdles. The comparison between RTs in Edmonton and in Paris, during the different qualifying rounds, is shown in Figures 1 (100m men) and 2 (100m women), Figure 3 (110m hurdles) and Figure 4 (100m hurdles). In Figure 5, the PTs and RTs of the nine sprinters who competed in both Edmonton and in Paris are compared.

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Figure 3: Reaction time (mean ± SD) registered in different rounds of the 110 metres hurdles in Edmonton 2001 and Paris 2003

Figure 4: Reaction time (mean ± SD) registered in different rounds of the 100 metres hurdles in Edmonton 2001 and Paris 2003
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**Figure 5**: Performance and reaction time (mean ± SD) of 100 metres sprinters (men and women) competing in both Edmonton 2001 (OR) and Paris 2003 (NR).

**Figure 6**: Performance and reaction time (mean ± SD) of 100 metres and 110 metres hurdlers competing in both Edmonton 2001 (OR) and Paris 2003 (NR).
Similarly, Figure 6 shows the PTs and RTs of nine male 110m hurdlers and eight female 100m hurdlers who competed in both Edmonton and in Paris.

**Discussion and conclusions**

The aim of this study was to determine if the RT of elite athletes was slowed in major championships after the introduction of the new false start rule. It was found that there was a tendency for RT to be slower in the Paris finals (NR) compared to Edmonton (OR), especially in 110m and 100m hurdle races (Figures 3 and 4 respectively). Conversely, however, the slowing of RT was not observed with such consistency in the 100m races, since significant differences were only identified in three out of eight comparisons (Figures 1 and 2).

To gain a closer reflection of the effect of the NR on RT, it was possible to compare athletes who competed in both Edmonton (OR) and Paris (NR). When comparing the RTs and PTs of these athletes, although the differences were not significant in either sprinters (Figure 5) or hurdlers (Figure 6), it was found, once again, that hurdlers had, on average, a slower RT in Paris (NR) compared to Edmonton (OR).

Overall, given the opposing findings in sprinters and hurdlers, the results from this study show that it is not possible to state with certainty whether the new false start rule has affected the RT of elite athletes. However, it should be acknowledged that hurdlers (men and women) had slower RT in Paris than in Edmonton but the 100m sprinters did not. It is beyond the scope of this study to explain why hurdlers might have been affected more than sprinters but future studies should consider psychological and/or technical factors that might influence RT. In addition, further studies should also consider any changes in the number of disqualifications or debated incidences as a result of the rule change.

**References**


4) BUCKOLZ, E.: Sprint start reaction time: should one attend to the input or the output or does it matter? Can J Appl Sport Sci, 1980, 5 (3): 146-152


8) http://www2.iaaf.org/WCH01/Results/by Event.html

9) http://www.iaaf.org/WCH03/results/by Event.html

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