The men's Long Jump

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1 Introduction

In 1968 at the Games of the XIXth Olympiad in Mexico City, Bob Beamon (USA) set a World Record of 8.90m in the Long Jump. At the time it was thought by some that the performance might never be bettered. The press called it 'the dream record', even though it was set at altitude, and it stood for almost 23 years. However, with the rise to prominence of such excellent athletes as Carl Lewis and Larry Myricks (USA) it became likely that the record would fall, eventually even at sea-level.

In the final of the Long Jump at the III World Championships Beamon's record was broken by Mike Powell (USA), who won the event with a distance of 8.95m. Carl Lewis (USA) also exceeded Beamon's record with a leap of 8.91m to take the silver medal.

In this report we will compare data obtained by the JAAF/IAF Biomechanics Research Team on the jumps of Powell and Lewis in Tokyo with their best performances at the Games of the XXIVth Olympiad in Seoul, 1988 and with existing data on Beamon's jump.

Table 1 gives the full results of the men's Long Jump final.

2 Methods

The jumps of all the finalists were recorded from run-up to landing using 16 mm cine-cameras and high-speed video-cameras. The films were then analysed using the Direct Linear Transformation method.

3 Results and discussion

Table 2 shows the basic kinematic data obtained from Beamon's performance in 1968.
Table 1: Results of the men's Long Jump final

<table>
<thead>
<tr>
<th>Place</th>
<th>Name</th>
<th>Country</th>
<th>Best mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mike Powell</td>
<td>(USA)</td>
<td>8.95(WR)</td>
</tr>
<tr>
<td>2</td>
<td>Carl Lewis</td>
<td>(USA)</td>
<td>8.91(w)</td>
</tr>
<tr>
<td>3</td>
<td>Larry Myricks</td>
<td>(USA)</td>
<td>8.42</td>
</tr>
<tr>
<td>4</td>
<td>Dietmar Haaf</td>
<td>(GER)</td>
<td>8.22(w)</td>
</tr>
<tr>
<td>5</td>
<td>Bogdan Tudor</td>
<td>(ROM)</td>
<td>8.06</td>
</tr>
<tr>
<td>6</td>
<td>David Culbert</td>
<td>(AUS)</td>
<td>8.02</td>
</tr>
<tr>
<td>7</td>
<td>Giovanni Evangelisti</td>
<td>(ITA)</td>
<td>8.01</td>
</tr>
<tr>
<td>8</td>
<td>Vladimir Ochkan</td>
<td>(URS)</td>
<td>7.99(w)</td>
</tr>
</tbody>
</table>

Mexico City, and from the performances of Powell and Lewis in Seoul and Tokyo.

It is obvious from the table that Powell's jumping underwent a great improvement between the 1988 Olympic Games and the 1991 World Championships. During the three interim years he increased his speed capacity and polished his take-off technique so that he was able to achieve a greater vertical velocity. His run-up velocity and projection angle at take-off increased from 10.6m/sec. and 17.9 degrees respectively (Seoul) to 11.0 m/sec. and 23.1 degrees (Tokyo).

In this respect it could be said that Powell's winning jump in Tokyo was technically similar to Beamon's Mexico City jump: his centre of gravity's highest point during flight was 1.93m; the highest point of Beamon's was 2.00m. Lewis's best jump, on the other hand, was characterized by its relatively low projection angle (18.3 degrees), relying instead on a high horizontal velocity. His CG's highest point during flight was 1.71m.

Considering that the projection angle in most long jumpers ranges from 15 to 25 degrees, the jumps of Powell and Lewis may be described as 'high' (23.1 degrees) and 'low' (18.3 degrees) jumps respectively. In order to indicate the take-off characteristics the following were analysed for both athletes: the trajectory of CG during take-off; the angle of

Table 2: Kinematic data for the Long Jump - Beamon (Mexico City 1968); Powell and Lewis (Seoul 1988 and Tokyo 1991)

<table>
<thead>
<tr>
<th>Athlete</th>
<th>Competition</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>Official distance (m)</th>
<th>Effective distance (m)</th>
<th>Wind velocity (m/sec.)</th>
<th>Run-up velocity (m/sec.) (x)</th>
<th>Initial velocity (m/sec.) (z)</th>
<th>Projection angle (degrees)</th>
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</thead>
<tbody>
<tr>
<td>Beamon</td>
<td>OG 1968</td>
<td>190</td>
<td>75</td>
<td>8.90(WR)</td>
<td>7.92</td>
<td>2.0</td>
<td>10.99</td>
<td>8.80</td>
<td>24.0</td>
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<tr>
<td>Powell</td>
<td>WC 1991</td>
<td>188</td>
<td>77</td>
<td>8.95(WR)</td>
<td>9.00</td>
<td>0.3</td>
<td>11.00</td>
<td>9.09</td>
<td>23.1</td>
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<tr>
<td>Powell</td>
<td>OG 1988</td>
<td>188</td>
<td>77</td>
<td>8.49</td>
<td>8.57</td>
<td>1.8</td>
<td>10.60</td>
<td>9.50</td>
<td>17.9</td>
</tr>
<tr>
<td>Lewis</td>
<td>WC 1991</td>
<td>188</td>
<td>79</td>
<td>8.91(w)</td>
<td>8.91</td>
<td>2.9</td>
<td>11.06</td>
<td>9.72</td>
<td>18.3</td>
</tr>
<tr>
<td>Lewis</td>
<td>OG 1988</td>
<td>188</td>
<td>79</td>
<td>8.72</td>
<td>8.90</td>
<td>-0.2</td>
<td>11.00</td>
<td>9.30</td>
<td>20.8</td>
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</tbody>
</table>
Figure 1: Representation of the jumps of Powell (above) and Lewis (below)

Figure 2: Trajectory of CG during take-off for Powell and Lewis
inclination of the body at touchdown; and the
knee angle during take-off.

Figure 2 shows the trajectory of CG during
take-off. At touchdown, Powell’s centre of
gravity in the vertical position was lower than
that of Lewis; on the other hand, at take-off
it was much higher.
Powell leaned further backwards than Lewis
at touchdown. The angle made by a straight
line from CG to the toe of the take-off leg
with the ground at the instant of touchdown
was 130 degrees in the case of Powell and 126
degrees in the case of Lewis.

Powell’s knee extension of the supporting
leg during take-off was greater than Lewis’s.
The knee angles of the take-off leg at the
instant of touchdown, maximum flexion and
take-off were 171, 148 and 171 degrees
respectively for Powell and 165, 140 and 171
degrees for Lewis.

Generally, there are two types of techni­
que for planting the lead foot in preparation
for take-off. In the first, the foot may be
brought to the ground with a backward­
sweeping movement. In this way it assists in
limiting the loss in horizontal velocity experi­
enced during the take-off. The second techni­
que, a ‘locking’ placement of the foot,
involves a plant in which the foot is neither
moving forwards nor backwards relative to
the CG at the instant of touchdown. This
technique is believed to facilitate an increase
in the vertical velocity of CG at take-off.

It could be inferred from the collected
data that Powell achieves a greater vertical
velocity and higher angle of take-off by using
the ‘locking’ placement of the foot; Lewis on
the other hand relies on an ‘active landing’
technique and a lower angle of take-off which
facilitates a relatively high horizontal velocity.

REFERENCE
IAAF (1990): Scientific research project at the Games of the
XXIVth Olympiad, Seoul 1988