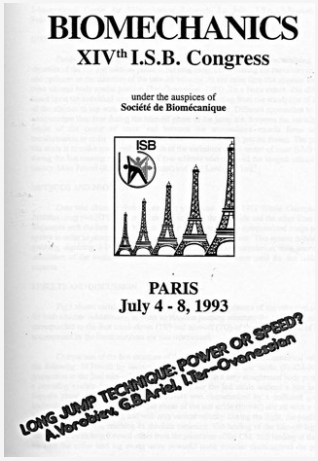
Long Jump Technique: Power or Speed?

Comparative analysis of two athletes who achieved the longest official jumps in history: Mike Powell (8.95m World Record) and Carl Lewis (8.91m).



Code	**adi-pub-01140**
Title	Long Jump Technique: Power or Speed?
Subtitle	Comparative analysis of two athletes who achieved the longest official jumps in history: Mike Powell (8.95m World Record) and Carl Lewis (8.91m).
Name	ISB
Author	Gideon Ariel
Published on	Tuesday, July 6, 1993
Subject	APAS; Biomechanics; Digitize; Discus; Journal; Performance Analysis; Science; Transform
URL	https://arielweb.com/articles/show/adi-pub-01140
Date	2013-01-16 15:40:46
Label	Approved
Privacy	Public

Long Jump Technique: Power or Speed?

This study by A. Vorobiev, G.B. Ariel, and I. Ter-Ovanessian compares the long jump techniques of two athletes who achieved the longest official jumps in history: Mike Powell (8.95m World Record) and Carl Lewis (8.91m). The research aims to analyze the variations of the center of mass (CM) velocities during the last running strides of the athletes.

Data was obtained during the men's long jump final of the 1991 World Championships in Athletics using two NTSC cameras. The results showed significant differences in the athletes' techniques. Powell preserved all the momentum gained till the last surface interaction and converted it into the launch velocity in a single "high strain" motion. In contrast, Lewis started partial transformation of horizontal velocity of the approach to the vertical component by the upward motion of the center of mass much earlier, dividing the process of the speed transformation between two strides.

The study concludes that these two different approaches might be used as guidelines in selecting and structuring the training basis for an athlete, considering their individualities, training, and competitional backgrounds.

Below find a reprint of the 4 relevant pages of the article "Long Jump Technique: Power or Speed?" in "ISB":

BIOMECHANICS

XIVth I.S.B. Congress

under the auspices of
Société de Biomécanique

PARIS
July 4 - 8, 1993

LONG JUMP TECHNIQUE: POWER OR SPEED?
A.Vorobiev, G.B.Ariel, I.Ter-Ovanessian

LONG JUMP TECHNIQUE: POWER OR SPEED?

A. Vorobiev,[1] G.B. Ariel,[1] I. Ter-Ovanessian[2]
1-International Center for Biomechanical Research, La Jolla, USA, 2-Russian Athletic Federation, Moscow, Russia

INTRODUCTION

Fundamental distinction lies in the different approach used in materializing the main objective of the run and take-off phase in the long jump, i.e. delivering the maximum to the value and optimum to the direction of the take-off velocity. At the same time this requires keeping the most rational body spatial position (Ter-Ovanessian, 1985). To a large extent, this difference is based upon the individual specifics in the locomotional training from the standpoint of the ability of the athletes to use various types of locomotion efficiently. Different approaches to the basic compromises they face during the take-off phase of the jump are: between the velocity and the height of the center of mass, and between the accumulated muscle force and speed transformation in order to achieve the maximum efficiency with precise timing. The purpose of this study is to make comparative analysis of the variations of the center of mass (CM) velocities during the last running strides of the of two athletes who achieved the longest official jumps in history: Mike Powell (8.95m World Record) and Carl Lewis (8.91m).

METHODS AND PROCEDURES

Data was obtained during men long jump final of the 1991 World Championships in Athletics using two NTSC cameras, one viewing from the right side and the other from the front. Sequences with the best athlete's attempts were processed by the computerized image processing system in order to obtain spatial kinematic pattern of joint's motions. This system provided frame grabbing, digitizing, 3-D transformation, synchronization and interpolation, data smoothing and calculation of the location of CM. Fourteen control points were used for the calibration of cameras.

RESULTS AND DISCUSSION

Fig.1 shows variations of horizontal and vertical components of the velocities of the CM for both athletes. Additionally, in order to visualize jumping structure the segment positions that corresponded to the foot touch-down (TD) and take-off (TO) of the support phase of the stride accompanied by the frame numbers are also represented.

Comparison of the fine structure of the locomotions basing on the numerical values gives the following: M.Powell by shortening of the second to the last stride (Fr.#24-36) started preparation to the final take-off. This allowed him to reach a very straightened body position with a prevailing straight-downwards motion and to enter the last stride without a loss in velocity. Support phase of the last stride (Fr.# 36-46) was characterized by a sufficient gain in the horizontal velocity (1.2m/s). The flight phase of the last stride (Fr.#46) started with a very high horizontal velocity (12.2m/s), and with zero vertical velocity. During the flight, the position of the CM dropped by 8 cm, reaching its absolute minimum. The landing of the take-off leg (Fr.#57) was marked by its long forward offset from the projection of the CM. Stiff landing of the take-off leg with the active lead leg swing using powerful trunk muscles characterized the process of

changing direction of the CM velocity. During the "rolling over" of the support leg the horizontal velocity dropped by more than 2 m/s, but at this expense the vertical gain of 4.2m/s was obtained (Fr.#66). The resulting take-off angle was 24.6 degrees.

C.Lewis commenced the preparation to the final push during the support phase of the second to the last stride (Fr.#13-25) by the lowering of the CM by 3 cm. The athlete left the surface interaction with the forward trunk lean and high horizontal velocity (11.8m/s). At the same time vertical velocity was negative. The next stride was longer than the previous by 47cm. During this elongated stride, the position of the CM was lowered by 10 cm. CM height reached its absolute minimum in height at the amortization phase of the last stride (Fr.#38). After that, the CM started its upward motion. The last stride was shortened with no considerable vertical speed. The support leg was placed on the surface with a vertical downward motion without a pronounced "thrust". The following phase of the final push was characterized by whip-like motion of the swing leg and the extension of the support leg in the knee. The horizontal speed dropped by 1.4m/s (from 10.5 to 9.1) and the gain in the vertical speed was 3.4m/s. The take-off angle was 20.3 degrees.

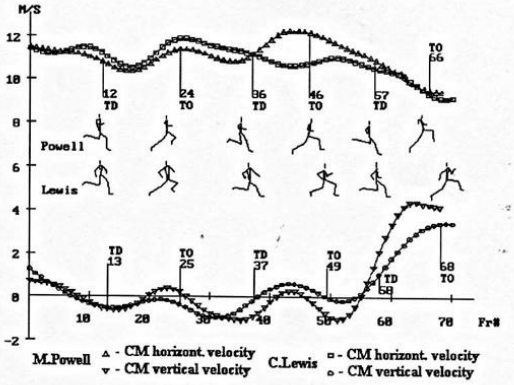


Fig.1. Velocities of Center of Mass during last strides of long jump.

CONCLUSIONS

Comparison of the original video recordings of the two attempts described above and confirmed by the instrumental recordings, show the number and the substantiality of the differences enough to consider these two jumps as belonging to two different "classes." Lewis started partial transformation of horizontal velocity of the approach to the vertical component by the upward motion of the center of mass much earlier. It allowed him to divide the process of the speed transformation between two strides. As a result, this process was not accompanied by the application of an accumulated momentum in a single high force surface interaction. On the contrary, Powell preserved all the momentum gained till the last surface interaction and converted it into the launch velocity in a single "high strain" motion. The jumping formula of Lewis is, in effect, the adaptation of the high speed sprinter techniques to the long jump. Mike Powell's formula has a much more pronounced force orientation. This technique predetermines much higher requirements to the force exertion capabilities in the training pattern of an athlete. These two different approaches might be possibly used as guidelines in selecting and structuring the training basis for an athlete, with due consideration of his or her individualities, training and competitional backgrounds.

REFERENCES

Ter-Ovanessian, I. (1985) Long jump fundamentals. *XIII congress of the European athletics coaches association. The jumps.* Birmingham, England.

Scientific research project at the games of XXIV Olympiad - Seoul 1988. Bruggemann, G. and Glad, B. (ed) International Athletic Foundation (1990), 263-301.