CHARACTERISTICS OF THE LONG JUMP TECHNIQUE

By Dr. Heinz Weidner, Dr. Harmut Dickwach

The authors from the German Democratic Republic discuss the run-up, take-off, flight and landing phases in a model target technique of the long jump and list some performance prerequisites for the event. The article is a translated summary of the text that originally appeared in Der Leichtathlet, No.27, July 1989. Re-printed with permission from Modern Athlete and Coach.

The long jump depends more on specific prerequisites and talent than most other track and field events. This statement is based on the results of various studies, showing that the technique of a long jumper had little differences in the junior and high performance ages. It applies particularly to the largely established run-up and take-off phases. The learning of the basic technique elements is therefore a most important aspect in the long jump.

The structure of a model technique for juniors and top level performers is well presented in numerous publications. In addition no essential technique changes were observed in the 1988 Olympic Games. Consequently, this text attempts to present some selected aspects of the long jump technique, based on the principles of training methods and biomechanics.

THE RUN-UP

A high run-up speed, an optimal preparation for the take-off and a high accuracy of the takeoff are the main factors deciding the following phases of the jump. The run-up velocity is expressed in the available kinetic energy of the athlete’s centre of gravity; it should have the highest possible value that can be transferred into the take-off. To achieve this, the majority of long jumpers employ the following length run-ups:

- Men: 42-46m, corresponding to 19-22 strides
- Women: 37-43m, corresponding to 18-22 strides.

Attempts to extend the run-up (50m and over) have so far been unsuccessful as far as jumping distances are concerned. Experience has shown that longer run-ups create problems in the maintenance of the run-up “dynamics” and velocity. It also can be assumed that it will require more energy, affecting the jumping capacity and therefore the efficiency of the jump.

There have been numerous studies looking into the correlation of the run-up velocity and the distance jumped. These have been based on systematic electric timing of the athletes last 5m in the run-up. The times over the last 5m in the run-up allow establishing, besides the velocity, targets for the relationship between the run-up — jump — distance. There is a general difference between men and women jumpers in this relationship. Men, because of their superior jumping capacity, achieve better distances from the same run-up velocity. The difference in the range of 0.50 sec. over the last 5m is about 30 to 60cm.

For juniors, whose jumping capacity is not yet fully developed, but who are reaching run-up speeds close to those of the seniors, the following can be used as a guide:

- Men:
    - 7.80m from 0.50 sec.
    - 8.00m from 0.48 sec.
- Women:
    - 6.50m from 0.55 sec.
    - 6.80m from 0.53 sec.

The high run-up velocities in the long jump are achieved by an acceleration run. There are two different basic variations available for the exploitation of the acceleration capacity of an athlete:

- A run-up in which the acceleration capacity is exploited over the whole run-up distance. This variation has been successfully used by GDR athletes and is observed in nearly all USA jumpers.
- A run-up with a sub-maximal structure in which the intensification of the acceleration includes a conscious preparation for the takeoff. This variation was common among USSR jumpers.

The run-up is usually divided into two or three phases. In a two-phase approach it is made up from an acceleration phase (usually beginning with preliminary strides), followed by a preparation phase for the take-off. The last occurs over the final six strides and is characterized by a shortening of strides and increasing the stride frequency.

A three phase run-up has an acceleration phase of about 10 strides in a typical sprint acceleration style with a forward lean. Next comes a transition phase from acceleration to speed maintenance. The final phase for the preparation of the take-off takes place in the last four strides.

Available data (table 1) on the last two part distances (1 to 6m and 6 to 1m) indicates that in the majority of good jumps there is a time improvement from 0 to 0.03 sec. Differences indicate:

- A sub-maximal acceleration or an acceleration that took place too late,
- A run-up that is not sufficiently long.

TABLE 1: Average run-up speeds of the finalists in the 1987 world championships and 1988 Olympics.

	11 - 6m	6 - 1m
Men 1987 1988	0.473 sec. 0.472 sec.	0.473 sec. 0.469 sec.
Women 1987 1988	0.536 sec. 0.527 sec.	0.531 sec. 0.525 sec.

It is interesting to note here the comparison of Carl Lewis' and Heike Drechsler's split times in the 100m finals and their times over the last 5m in the long jump finals at the 1988 Olympics (Table 2).

TABLE 2: Comparisons of Lewis' and Drechsler's split 100m times with their times over the last 5m in the long jumps.

	Split time 40-50m	Best 5m in run-up	% Differences
Lewis (USA)	0.86 sec. (0.43 sec.)	0.447 sec.	-3.9%
Drechsler (GDR)	0.97 sec. (0.485sec.)	0.501 sec.	-3.3%

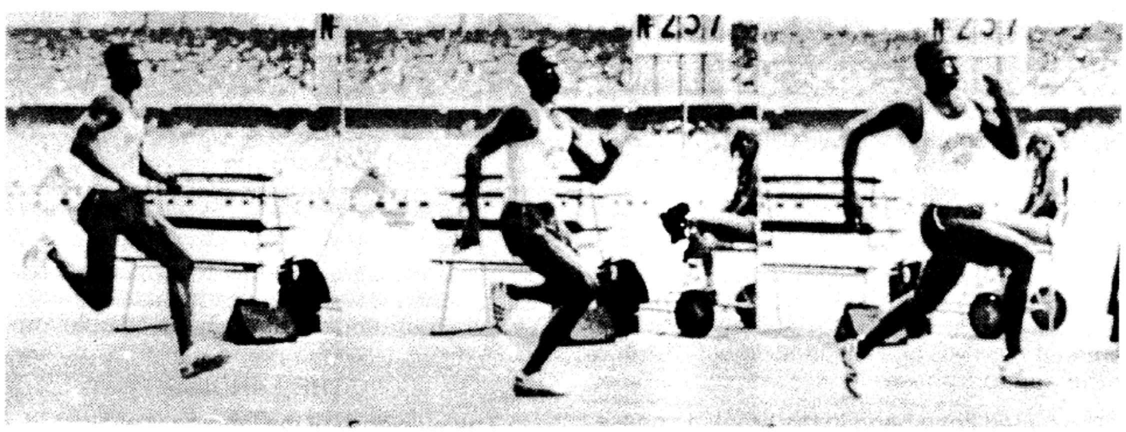
A model target of the accuracy of a run-up is to reach the board within 5cm of the take-off line. The achievement of this target, without changing the structure of the last run-up strides, sets heavy demands on:

- The stability of the stride structure;
- The stability of the structure and rhythm of the last run-up strides;
- The ability to correct small deviations in the final approach to the board;

Most athletes use check marks as a guide in the run-up. Check marks can be used in training for the control and adjustments of the acceleration phase, as well as the preparation phase for the take-off (4 to 6 last strides). Check marks have no value in competition, as the athlete's concentration should be fixed on the take-off board. The use of one or two check marks in competition can only inform the coach of possible shortcomings.

TAKE-OFF PREPARATION

The preparation phase for the take-off aims to provide, through a change in the movement structure, the best possible conditions for the take-off. This takes place over the last 12m (4 to 6 strides) of the run-up. The last 2 to 4 strides show particularly noticeable deviations in which the proportion of the stride length is changed and the athlete's centre of gravity is lowered.



TAKE-OFF PREPARATION — THE PENULTIMATE STRIDE
Larry Myricks (USA) in action during the penultimate stride.
The authors claim his two last strides are equal length.

The lowering of the centre of gravity in the penultimate stride is expected to change the acceleration path to a more vertical direction and therefore create stronger vertical force impulses. This means an improvement of the take-off parameter, provided the change in the stride structure is performed without horizontal velocity losses.

TABLE 3: The length of the penultimate and last strides in the long jump (1987 information)

Name	Year	Distance (m)	Penultimate Stride (m)	Last Stride (m)	Difference (m)
Paschek	1980	8.36	2.46	2.01	0.45
Dombrovski	1984	8.50	2.55	2.25	0.30
Lewis	1987	8.67	2.47	1.82	0.65
Myricks	1987	8.33	2.06	2.06	0.00
Hirshberg	1987	8.16	2.42	2.45	-0.03
Beamon	1968	8.90	2.40	2.60	-0.20
Drechsler	1984	7.21	2.30	2.13	0.17

The basic variation of the lowering of the centre of gravity takes place with a lengthening of the penultimate stride in comparison to the previous and the following strides. Studies indicate that in the majority of cases the last stride is between 84.5 to 97.5% shorter than the penultimate stride (table 3). At the same time, routine stride measurements in competitions have shown that in a number of athletes the last two strides are of equal length. In the world record jump of

Bob Beamon's his last stride was even longer than the penultimate stride. This variation, however, has not been observed in other world-class jumpers.

THE TAKE-OFF

The task of the take-off is to direct the athlete's centre of gravity actively upwards at an angle corresponding to 21° to 24°. It begins when the athlete plants the take-off leg, bent about 170° in the knee joint, with a 10° to 15° angle in the foot, on the take-off board. The transfer into the actual take-off from the support begins when the optimal angle in the knee joint has been reached. The extensor muscles of the take-off leg begin their stretching movement during which the velocity of the athlete's centre of gravity is again increased until the end of the support phase.

The forced knee bend in the breaking phase of the take-off should not exceed the optimal angle, as this would create too much tension in all the muscles participating in the extension of the leg and lead to a drop in the movement velocity. A virtually flat planting of the take-off foot on the board is regarded to have an advantage in keeping the negative influences on the support and movement systems relatively low in the passive phase of the foot plant.

The take-off results not only from the activities of the take-off leg but also significantly from the accompanying swinging elements (both arms, lead leg). The main influence comes from the lead leg because of the mass involved. It should perform a short pendulum movement, achieved by keeping the lower leg close to the seat. The thigh of the lead leg reaches a close to horizontal position at the same time the take off leg completes its extension. There is a narrow angle between the thigh and the lower leg of the lead leg and the upper body is upright or has a slight backward lean (about 5°).

THE FLIGHT

The main tasks of the flight phase are:

- The maintenance of balance and the counteraction to any forward impulses.

- The preparation for an effective landing.

Biomechanical aspects and practical experience indicate that a 2 ½ - stride hitch-kick can be regarded as a model target technique for the flight phase. Emphasis is directed to the following part movements:

- An early straightening of the lead leg after its contribution to the take-off has been fully exploited.

- A wide backward movement of the lead leg simultaneously with the forward movement of a bent take-off leg.

- A coordinated circling of the arms, similar to a natural running movement.
- A forward-upward lift of the legs in the final stage, combined with a forward lean of the trunk and downward directed arms.

The wide movement structure of the 2 ½ - stride hitch-kick requires a corresponding time in the air to avoid a passive pre-landing phase, responsible for the lowering of the legs. The number of athletes using the 3 ½ - stride hitch-kick is limited because it is difficult to learn and needs more time in the air for completion.

THE LANDING

The efficiency of the landing is evaluated according to the ability to use the available velocity of the centre of gravity in the correct direction in the final phase of the flight. The difference between the theoretical flight distance and the measured distance should be as small as possible. The aim is to reach a low position of the centre of gravity and place the feet horizontally well ahead of it. These tasks are achieved through a movement pattern that creates a minimal hip angle (the trunk has been moved closed to the thighs) at the moment the feet break the sand. The difference between the hips and heels height should be as small as possible. The formation of the desired hip angle is assisted by the position of the head in a straight line with the upper body axis.

The lowered arms should be at their lowest level at the moment of the landing to keep the centre of gravity low and to keep the sinking of the legs minimal. The bend in the knee joints at the landing is between 150° to 170° with the aim to reach values below 150° in the future. A landing with a strong backward lean of the trunk is from the biomechanical viewpoint inefficient because it makes poor use of the flight parabola.

A number of athletes perform a sideways landing in the long jump. No studies appear to be available at this stage in favor or against this landing procedure. Biomechanically it can be estimated that:

- The sideways placement of the legs at the landing leads to a favorable reduction of the height of the centre of gravity,
- The sideways placement of the legs restricts the maximal distance the feet can be brought forward,
- The position of the legs and upper body in the sideways placement doesn’t allow an assisting arm action.