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# Long jump with supramaximal and normal speed

by Agoston Schulek

ABSTRACT

*The study conducted by the author investigates the use of assisted towing in addressing the issue of whether such technology can directly benefit long jumpers in their quest to repeatedly achieve or go beyond 100% maximum runway speed levels.*

*The value of assisted towing is widely acknowledged at high performance level for sprinters but the case had not been proven for long jumpers. The author utilises the best horizontal jumpers in Hungary and the "Speedy" equipment system in an attempt to discover whether assisted towing can have a direct positive effect on long jump performance levels for experienced international standard athletes.*

*The study undertaken shows quite conclusively that assisted towing can be of great benefit to high level long jumpers with a stable technique. Higher runway speed levels were achieved by all 8 athletes tested, without any resulting deterioration in technique or performance levels. They were each asked to perform 6 jumps, 3 using the technology and 3 without doing so, and 2 normal jumps and 2 assisted jumps were analysed for each athlete. The jumpers used a 14 stride approach, the most frequently utilised runway approach in training, which represents approximately 75% of the normal competition run up length.*

*In the view of the author, the most important result achieved was the clear improvement in the horizontal component of the take off. The most common characteristics were not only an increase in take off speed but also a decrease in ground contact time at take off. This is highly significant because a shorter ground contact ensures less energy loss and an increase in performance, as well as a capacity to produce more jumps of an equivalent level. This is due to not only the saving in energy but the fact that there was no additional loading on the take off leg, despite the increased length of the jumps.*

*The athletes tested all achieved increased jump distances in using the Speedy equipment and, although the average take off angle decreased by 1.4 degrees, it was more than compensated for by the increase in jump distance. The easier acceleration achieved with assisted towing also seemed to provide improvements in rhythm, stride structures and body position. With a study group of experienced international standard athletes, no negative aspects in relation to take off execution or flight technique were in evidence.*

AUTHOR

*The author has been assistant professor at the Hungarian Sport University since 1974. Since 1986 he has lectured at IAAF and Olympic solidarity coaching courses. He coached top Hungarian athletes in national and international level and was president of the Hungarian Athletic Association between 1991-2001. Since 1999 he has been Vice Chairman of EAA Development Committee and Vice President of the European Athletic Association and the Hungarian Athletic Association*

I have worked as an active coach for over two decades and have achieved my best results with long jumpers. A target of improving personal best performances has always been my main aim. During an age of drug use in sport I have always tried to utilise legal aspects that can successfully help athletes in their preparation and training.

Due to the improvements made in training methods, the physical preparation of the athletes is now more definite and crystallised than any aspects of improvement in their jumping techniques.

For years I have experimented with numerous preparation methods to enable my athletes to approach their expected competition results during training. In this context, the possibility of offering greater speed of approach to the long jump take off, either equivalent to or in excess of the speed and movement performed in the competition environment, has obvious benefits to the coach and athlete. During training we have experimented with the constant electronic and manual control of the run-up speed, in an attempt to motivate the jumpers to achieve greater speed. The performances registered have shown no improvement. On the contrary, they have become tense and forced, with a deterioration in jumping technique.

We have often used a raised take-off board, elevated 20cm above ground level, and found that skilled athletes were able to achieve their competition results from 75% of their normal run-up length. This proved to be useful but since it greatly changed the technical structure of the take-off, we did not use it in the competition season for fear of creating a false technique.

These are the reasons why we have been keen to find any possibility that could provide regulated help for making training more effective and fruitful.

Sprinters have been using the assisted tow method for years in order to increase sprinting speed. This has also become popular among sprinters in Hungary and its usefulness is acknowledged all over the world.

During our studies we tried to ascertain whether the assisted towing method could be directly used for benefit with long jumpers.

Introduction to the athletes studied and an outline of the methodology used.

*We examined a variety of jumps achieved by eight national top level athletes:*

*Table 1: Data of the jumpers involved in the study*

| Name | Birth date | Weight | Height | Best result |
|---|---|---|---|---|
| S. Beres | 1970 | 70 kg | 182 cm | 748 cm |
| Zs. Czingler | 1971 | 72 kg | 186 cm | 758 cm |
| D. Foszto. | 1972 | 69 kg | 179 cm | 670 cm |
| Zs. Kurtosi | 1971 | 85 kg | 188 cm | 723 cm |
| T. Margl | 1976 | 76 kg | 190 cm | 723 cm |
| S. Munkacsi | 1969 | 83 kg | 184 cm | 765 cm |
| T. Ordina | 1971 | 74 kg | 192 cm | 804 cm |
| D. Szabo | 1967 | 83 kg | 184 cm | 765 cm |

The participants in the study had all been regularly training and competing for over 5 years and they all possessed a mature and secure jumping technique. Some of them had already used the assisted towing method to increase their sprinting speed during training, but they had not used the Speedy technology before.

We conducted the study in the indoor hall of the Hungarian University of Physical Education. The synthetic surface and the hard wood surface of the platform made it possible for the athletes to jump in spikes, just as they would in competition.

We asked all the athletes in the study to perform six jumps, three normal efforts and three with the towing method. To ensure the same number of elements, we ultimately analysed two normal and two towed jumps for each participating athlete.

The jumpers used a 14-stride run-up (approximately 30m), which is equivalent to 75% of the normal competition run-up length and is the most frequently used distance in training.

## The measuring tools

The "Speedy Junior" equipment was used as the towing device.

We fixed the rope of the Speedy 34metres from the take off board, attaching it in such a way for it to release 14m from the board, ensuring that the jumper was able to perform the last 6 strides freely, without being towed. These 6 strides equal the distance between the take-off and the most often used control mark. We think that these 6 strides are sufficient for the athlete to correct any possible body balance loss caused by the greater speed achieved by being towed. In other words, the last 6 strides provide enough time for the jumper to satisfactorily prepare for take-off.

Since we could not ensure constancy in the speed and strength of the tow, the towing role was carried out by the same person for that particular training session in order to provide the most consistent help.

According to the practice used world wide for analysing run up speed, we measured by photocell the last 10m for speed (2x5m) with the final photocell placed 1m from the board (11-6m and 6-1m).

We placed the sensors of the photocells at a height of 120cm on either side of the run up track, 140cm away from each other.

To measure the parameters of the take-off force and time we used a 400X600mm net area surface, 3-dimensional Kistler platform equipped with piezo electrical sensors, which was placed at track level.

To establish the speed and angle of the jumper's take-off we used video recordings. (The shutter frequency of the camera was 50 pictures/second.) We placed the camera perpendicular to the direction of the run up, in the same direction as the take-off and 16m away from it, at a height of 1.60m.

To process the results of the video recordings and the speed and angle of the jumper's take-off, we used the APAS system which allows us to determine the exact take-off angle and speed data.

We measured the distance of the jumps with a steel tape from the take-off point to the rear mark left in the sand by the jumper.

## INDIVIDUAL ANALYSIS OF THE OUTSTANDING JUMPERS

What follows is an extraction of the best athletes' data, having taken into consideration relative values in the training context.

### Zsolt Czingler

Zsolt Czingler is the most successful Hungarian triple jumper who regularly competes in long jump too.Using the towing system his performance improved from 6.74m to 7.12m, a difference of 42cm.

Based on a study of the isolated statistics for his results the improvement in his performance is primarily due to the following changes:

Table 2: Comparative data of Zsolt Czingler's jumps

| | V6-1m m/sec | diff m/sec | tk msec | diff msec | Fx1 N | diff N | tx3 msec | diff msec |
|---|---|---|---|---|---|---|---|---|
| normal jump | 8,47 | | 138 | | 3504 | 138 | 131 | |
| towed jump | 9,43 | 0,94 | 118 | -20 | 4162 | 658 | 116 | 15 |

V6-1=last 5m speed, tk. = total take-off time, Fx1= peak of the horizontal concentric force , tx3= time from touch down to the peak of the horizontal force

On the first line of this table we show the most important indexes for a normal jump, and in the second table are figures for a jump performed with the towing technique.

It can clearly be seen from the highlighted data of the two different jumps that Zsolt Czingler's final speed significantly increased by almost 1m/sec.

In contrast, the duration of the take-off, in other words the contact time, significantly decreased! It should be mentioned here that our triple-jumper performed the shortest duration of take-off for both types of jumps.

The peak of the horizontal breaking force had increased greatly signifying the jumper's good physical aptitude.

The time of the peak of the horizontal force came closer to the touch down moment promoting a shorter contact time.

It is very important to state here that the above mentioned athlete achieved this performance improvement alongside a significant decrease in the take off angle. (3.2°)

## Sandor Munkacsi

This decathlete who achieved 6th place in the European Championships increased his performance with the use of the towing method by 63cm, improving from 6.82m to 7.45m. This outstanding improvement is reflected in the following data:

Table 3: Comparative data of Sandor Munkacsi's jumps

| | V6-1m m/sec | diff m/sec | tk m/sec | diff m/sec | Fx1 N | diff N | Vhor m/sec | diff m/sec | Vres. m/sec | diff |
|---|---|---|---|---|---|---|---|---|---|---|
| normal | 8,77 | | 141 | | 3255 | | 7,9 | | 8,3 | |
| towed | 9,61 | 0,84 | 120 | -21 | 4114 | 859 | 8,7 | 0,8 | 9,1 | 0,8 |

V hor.= the horizontal take-off speed of the CG
V res.= the effective take-off speed of CG

What is most typical is an increase in speed at the end of the run up and a decrease in contact time during take-off.

We have to stress the increased horizontal breaking force which results in a smaller than average decrease in the take-off angle.

Another very important factor is the 0,8m/sec improvement in take-off speed!

## Dezso Szabo

Dezso Szabo is a many time Hungarian champion and national record holder for the decathlon, who came 4th in the Olympic Games. He did not achieve a considerable improvement in performance during the study but, because of some very interesting changes witnessed, it is of interest to analyse his jumps.

We compared the 6.97m normal jump with the towed 7.12m jump.

The improvement was "only"15cm.

Table 4: Comparative data of Dezso Szabo's jumps

| | V6/1m m/sec | diff m/sec | Fx1 N | diff N | Fx3 N | diff N | Vres. m/sec | diff | Vdeg | diff |
|---|---|---|---|---|---|---|---|---|---|---|
| normal | 8,47 | | 3498 | | 310 | | 2,7 | | 18,9 | |
| towed | 9,80 | 1,33 | 4282 | 784 | 366 | 56 | 3,4 | 0,7 | 23,6 | 4,7! |

Fx3= maximum horizontal take-off strength
Vdeg.= take-off angle of CG
Vres.= vertical take-off speed of CG

The improvement in running speed was significant but this was not achieved at the expense of a decrease in contact time! It seems to be a result of a not too well executed take-off.

A speciality of his jumps is the similar contact time in the two types of jumps. A great improvement in Szabo's results would have been brought about if he had been able to decrease the contact time.

## Tamas Margl

The improvement by Tamas Margl of 64cm was the best among the jumpers, increasing his performance from 6.70m to 7.34m as a result of towed assistance.

Table 5: Comparative data of Tamas Margl's jumps

| | V11-6m m/sec | diff m/sec | Fx3 N | diff N | Fx1 N | diff N | Imp Nsec | diff Nsec | Vres. m/sec | diff m/sec | Vdeg m/sec | diff m/sec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| normal | 8,62 | | 3728 | | 2301 | | 4517 | | 7,8 | | 20,3 | |
| towed | 9,43 | 0,8 | 4194 | 466 | 4287 | 1986! | 4234 | -283! | 8,4 | 0,6 | 21,7 | 1,4 |

v11-6=the penultimate last 5m
F3= the maximum force of the take-off
Imp.= the impulse of the vertical force of take -off

He achieved his outstanding improvement without a decrease in run up speed in the latter stages of his approach. In the penultimate 5m he registered a significant speed increase and during the last 5m his speed did not change. This means that, with an identical speed, he was able to pay more attention to the correct execution of the take-off.

The simultaneous development of the take-off angle and speed is also significant. These components were the basis for this excellent improvement.

## Tibor Ordina

Tibor Ordina achieved in the Atlanta Olympic Games the best results in all aspects of our study.

The 7.07m result with a normal run-up improved to 7.68m as a result of the towing method. This 61cm improvement is a great result at this high level of performance.

Table 6: Comparative data of Tibor Ordina's jumps

| | V6-1m m/sec | diff | Tk m/sec | diff m/sec | Fx3 N | diff N | tx1 m/sec | diff m/sec | Vdeg | diff |
|---|---|---|---|---|---|---|---|---|---|---|
| normal | 9,25 | | 151 | | 450 | | 134 | | 21,3 | |
| towed | 9,61 | 0,36 | 132 | -19 | 712 | 262 | 111 | -56 | 23 | 1,7 |

The final speed of the run up increased by 0,36m/sec, which is a very good result in this speed domain.

The take-off time decreased by 19m/sec. The most important index of his result improvement is that besides the increased speed and decreased contact time, there is a 1.7° lower take-off angle!

This has probably been achieved by his high level of technical development.

## Questions and answers

When planning the study we asked ourselves the following points:

### Question:

Is it possible to use the towing method specifically for long jump?

### Answer:

As a result of our study we can state that technically well prepared long jumpers are able to use the towing method successfully, without any specific preparation.

### Question:

Is it possible to increase the length of the long jump clearance as a result of the towing method?

### Answer:

The distance of the jump increased more than we expected! (The biggest improvement was 64cm, the average was 36.25cm.)

### Question:

Are the athletes able to execute their individual jump technique at the end of a run up approach of artificially increased speed?

### Answer:

The unchanged jumping structure and the significantly increased distance of the jumps show that the jumpers are able to perform well at the end of a run up of increased speed.

### Question:

Will the towing method not destroy the structure of the take-off? (the ratio between the eccentric and concentric phases?)

### Answer:

The structure of the take-off did not change significantly.

To achieve better results it is useful if the peak of vertical force and the peak of horizontal force come closer to each other in time. It creates a more effective impact during the take-off.

### Question:

Is it possible to transfer the higher run-up speed into the jump? (in other words is it possible to increase the take-off speed as a result of the towed run up?)

### Answer:

In spite of the greater speed-loss during the take off, the take-off speed is higher for the towed jumps.

### Question:

Did the take-off angle change significantly for the towed jumps?

### Answer:

Despite the increased run up speed, the take-off angle decreased less than we expected! The difference was not significant in performance terms; the 1.4 ∞average take-off angle decrease is very small beside the significant (0,34m/sec) increase in the horizontal component of the take-off speed.

## Conclusions of the study that we can use in training

- The performance levels of the jumps increased much more with the towing method than we expected.
- The extended run-up speed, as a result of the towing system, did not create any technical or physical problems at the execution of the take-off or during the whole jump.
- Acceleration was much easier with the SPEEDY equipment.
- The 14 metres of free running after the tow was long enough for the jumpers to prepare for the jump.
- One of the most important positive results of the study is the fact that the run–up speed after towing did not decrease even during the second controlled 5m (6-1m from the board).

  It clearly suggests that the easier acceleration achieved by the towing method provided for improvements in rhythm, stride structures and body position.
- A clearly positive effect is the shorter take-off time, since a shorter ground contact ensures less energy loss and increases the performance of the jump.

- An important and significant message for training is that, in spite of the increased distance of the jumps, the peak force during the first part of the take-off did not increase!

  This is very useful because the increased force on the take-off leg will decrease or limit the number of possible jumps in a training session.
- We recognised that this peak force appeared earlier with the towed jumps as a result of the higher speed and this decreased the total time for the whole take-off.
- The clear improvement in the horizontal component of the take-off is the most important result! This improvement resulted in longer jumps in spite of a statistically minor decrease in the vertical speed component. This created the lower take-off angle.

Overall, we can state that due to the impact of the towing method, the result improved without significantly changing the structure of the take-off. Characteristically, the contact time decreased and the take-off speed increased. All the literature on long jump declares both as a positive effect for increasing long jump results.

In summarising the study we can clearly state that the towing method with SPEEDY is applicable not only for achieving maximal or sub-maximal sprinting speed, but also for preparing long jumpers in training to achieve higher runway speed during jumps, thus replicating the competition situation.

The artificially increased run-up speed did not provide negative technical changes or destroy the jumping technique.

The acceleration supported by SPEEDY needed less energy from the jumpers. Moreover, in spite of jumping further, the loading on the take-off leg did not increase. Therefore the athletes were able to execute more jumps in a training session of a higher quality.

In concentrating only on the length of the jumps as the result of the towing method (giving increases of 20-64cm), we can clearly state that the physically and technically better athletes are able to gain the greatest advantage. It means that the method is most effective amongst advanced long jumpers.

Our study concentrated only on long jump but, in principle, one could expect closely aligned results with triple jumpers since the take-off is very similar.

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