# PRINCIPLES OF THE ORGANIZATION OF TRAINING FOR HIGH PERFORMANCE ATHLETES

**By Prof. Yuri Verhoshansky**

*Well-known Russian sport scientist, Yuri Verhoshansky, presents his latest views on the organization of training for high performance athletes, based on the theory of the biological adaptation principles. The article is a slightly condensed translation from Teoriya I Praktika Fizicheskoi Kultuiy, Russia, No. 2, 1991.*

Contemporary demands in the preparation of high performance athletes, extremely high training and competition loads and an increased use of biologically active substances have raised doubts about the antiquated pseudo-pedagogical principles of the training methods used in the past. We have therefore turned to biology for help because biological aspects have over the last two decades contributed much to the contemporary theory of training. Biology holds an important position in the observation of the adaptation processes of an athlete's organism to heavy muscular workloads. The theory of training must therefore not conflict with the theory of adaptation but should be based on it. The biological aspect of the theory and methodology of training becomes particularly evident in the construction of a year's training cycle, which will be the subject of the following text. However, before going into a detailed analysis of the subject it will be necessary to refer to two important pre-requisites, namely:

1. Movement speed and its increase determine in most events the development of competition results and their progress. All preparation means (physical, technical, tactical, psychological, etc.) have therefore essentially one aim to create favorable conditions for the development of speed capacities that can be effectively exploited in competitions.

2. High performance qualifications are reached only by athletes who acquire a high level of technique even under extremely intensive loads. This means a technique that does not demand time and energy to improve it, but allows the athlete to concentrate on the development of movement speed of the competition exercise. Consequently one of the main objectives in a multi-year training program is the properly timed approach to solve the technical demands.

This leads us to the principles of the practical construction of training processes that are based on the latest information from literature and study results. Because the performance speed of the competition exercise is the main quality indicator, we begin with the establishment of a model for the "large training cycle" that leads to the final preparation for competitions.

MODEL VARIATIONS

There are in principle two variations available in the preparation for competitions (Fig. 1, I) that improve the speed (V) or the effort capacity (W) of the competition exercise. Long and middle distance runners, for example, proceed frequently from the following approach:

- It is important not to move away from the main task of improving speed.
- The speed developed during the summer season should be maintained in the winter.
- It is better to cover 100km a week at a specific speed level, rather than 200km at low intensities.

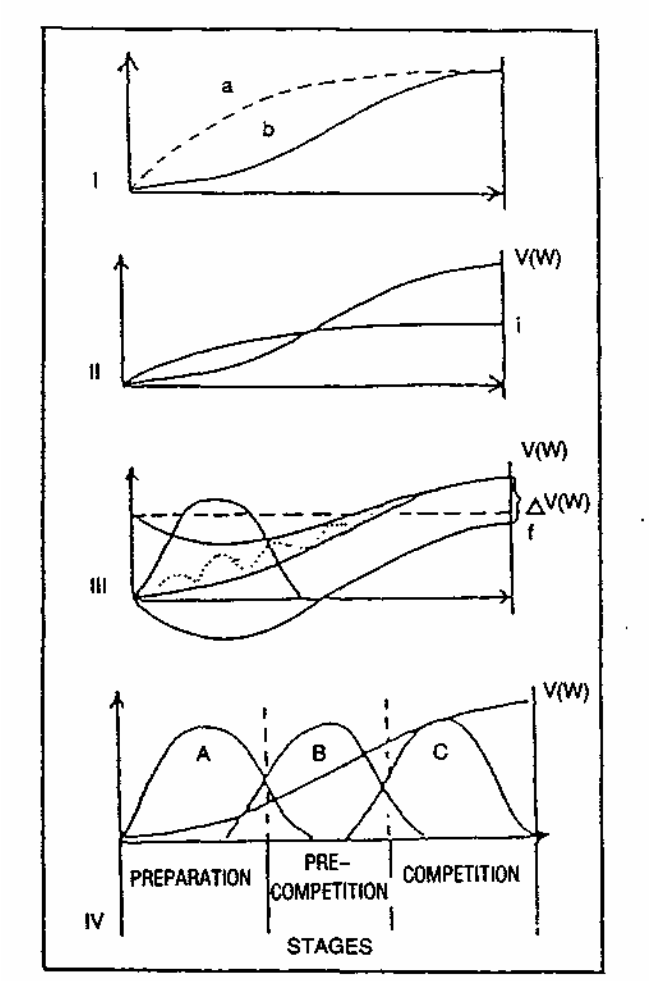


*FIG. 1: THE STRUCTURAL VARIATIONS OF A TRAINING YEAR*
*V = Speed; W = Performance intensity; A, B, C = Blocks*

Following this logic leads to the choice of the first variation and an enormous mistake. Increased intensity during the preparation period, particularly in the performance of the competition exercise, is responsible for only a temporary improvement of functional capacities and fails to develop a base for further improvement of the athlete's work capacity. Even worse, a premature development of speed and the use of anaerobic loads can be reflected in a negative influence on the total training process. The development of the morphological-functional specialization is slowed down and is likely to fail later to meet the demands of the maximal effort performances.

A far more sensible training variation would be the performance of the competition exercise with a gradually increased speed and power output (Fig. 1, I, variation b). This, in speed-strength events, allows preparing for large explosive loads and at the same time makes it possible to perform the competition exercise with a moderate tension. In cyclic events the athlete can first perform at optimal speeds (anaerobic threshold level) and gradually increase the load and intensity to develop further the cardio-vascular system and the contraction capacity of the fast and slow twitch muscle fibers.

On the other hand, exercises at moderate speeds over a long time period will not allow the organism to adapt to the speed regimen of the competition work. In this situation the muscle groups that carry the basic load in the cyclic events fail to reach the corresponding level of the vegetative systems and obstruct the improvement of the specific work capacity. In order to eliminate these factors it is advisable to perform competition exercises at moderate speeds at the beginning of the large training cycle and employ intensive specific physical preparation means (Fig. 1, II) only for muscle groups involved in the competition.

After this task has been solved the intensity of the competition exercise is gradually increased until maximal speed has been reached. This preparation strategy in the large training cycle assures that the intensity of the training processes is increased as a whole, taking into consideration that the adaptation inertia of the single organs does not have a negative influence on the total adaptation process. The realization of this strategy is based on the concentration of the specific physical preparation means at the beginning of the cycle (Fig. 1, III).

It would be wrong to think that the aim of the physical preparation is only the development of muscular strength. The strength capacities of skeletal muscles are secured from the energy produced from the corresponding biochemical processes (metabolic energy). The larger the energy released in a time unit, the larger is the movement potential, the larger is the volume of the used energy sources and the longer it is possible to maintain effective muscular work. Consequently specific physical preparation means have to develop above all the capacity of the organism to provide energy for effective specific muscular work.

It is therefore extremely important in the planning of specific physical preparation to find methods for the development of specific strength. Specific strength must correspond practically to the contractile, oxidative and elasticity qualities of the competition event to secure either the maximal level of the exertion capacity, or to improve the development of explosive power, or to develop local muscular endurance.

As a rule the concentration of specific physical preparation means (Fig. 1, II) leads to a drop in the specific work capacity indicators of an athlete (f), making it impossible to improve at the same time performance speed. However, the drop in the functional indicators is a temporary phenomenon. A so called long-term training effort, expressed in a constant improvement of the functional indicators, takes place following the concentrated specific physical preparation.

For this reason it is advisable to plan the specific physical preparation loads synchronized with technique and competition speed development loads, but keeping them temporarily separated. In other words, specific physical preparation means (loads) must in time take place ahead of technique improvement and competition speed development. As far as performance speed is concerned, the maximal value (V or W) drops first before it begins to improve to exceed finally the starting value (V, W).

## THE PRACTICAL MODEL OF THE TRAINING CYCLE

The above discussion has led to the beginning of a practical model of the large training cycle (Fig. 1, IV). Section A in the graph shows the physical preparation loads and section C the competition loads. Sandwiched between them are the loads (section B) that correspond to the turning point of the speed graph (V) and the improved restoration capacity of the specific functional indicators (f).

The structure indicates that the loads in section B play a particularly important role in the cycle, as they are directed to the adaptation of the organism to speed training. The large training cycle is therefore made up from three relatively independent stages with the aim to prepare the athlete for competitions:

- The preparation stage with the task to improve the motor potential of the organism for the following development of the competition exercise speed. This task is solved mainly by using specific physical preparation means.

- The pre-competition stage with the task to acquire the capacity to perform the competition exercise at close to maximal speed (effort). This is mainly achieved by the use of loads that correspond closely to the conditions of competitions.

- The competition stage with the task to lift the performance speed (effort) of the competition exercise to its potential limit.

A few additional remarks help to explain better the above outlined large training cycle. Firstly, the sections A, B and C (Fig. 1, IV) don't reflect the corresponding load volumes, but rather the trend of the training effect during the given stage. Secondly, in the actual practice it is necessary to plan for a transition stage. The need and the duration of the transition stage depend on the stresses occurring in the competition stage. Finally, and this is most important, the model reflects the main ideas for high performance athletes independent from the concrete time of competitions and the competition calendar.

The ideas must be realized in practice by using a creative approach and by taking into consideration the specificity of an event and the competition calendar. The attempts to create a universal "periodization" led to a dead end because every event needs its own system to construct training. Even closely associated events could need essentially different systems. For example, cyclic events are influenced by different distances and the main energy sources.

The number of training cycles and their duration is decided by the specific demands of competitions. For example, it is possible to have two large training cycles in a year (Fig. 2, I). In this case the main competitions usually take place in the second cycle. If three competition phases a year happen to occur, the contents and tasks of each cycle are decided according to the importance of the competitions. Whatever the case, it is important to understand that the model allows for flexibility. It is therefore common that the development of speed will take a wave-like character (Fig. 1, III).

## SOME BASIC PRINCIPLES

Training processes have since the beginning of the 1960's been treated as a series of microcycles that alternate according to the training demands. The different types of microcycles were looked at as "building blocks" for the construction of mesocycles, which in turn make up macrocycles. The content and organization of a macrocycle determines the "periodization" and form development aspects. This concept accepts the complex principle of training, using in parallel different direction training loads (technique, strength, endurance etc). The training effect of the large volume is regulated by a wave-like dynamics of large, medium and small volumes (waves).

The contemporary understanding of methodical training rejects this concept as unsuitable for high performance athletes, although it can be used in the training of beginners and recreational athletes. The main specific feature in the preparation of high performance athletes is the task to improve the athlete's motor potential. As the development process to improve the motor potential takes place according to biological laws of adaptation to intense physical work, we have come to the following conclusions:

- The training process is not a supplementary formation that is made up from a complex of microcycles but rather an integral process. The temporal aspect of the training process depends on the duration of the adaptation of the physiological system to the tasks and the functional rearrangement of the organism to a long-term adaptation. We can therefore not talk about the formation of training stages or periods without understanding biological processes and their phasic structures.

- Accepting the importance of the biological knowledge in the temporal format of training theory and methodology leads us in the long term adaptation to intense physical work and the need to organize training according to the so called large training cycle.

- The large training cycle is an independent part of the structure that corresponds to the relatively completed part of the long-term adaptation. The results of this cycle are expressed in the development of constant morphological changes in the organism and the stabilization of the functional capacities. It is important that the cycle is repeated at the time when the organism has reached a higher performance level than in the previous cycle. According to the competition demands the large training cycle can last from a year to around six months.

- A microcycle can’t, even theoretically, be an independent unit in the training process. A single microcycle, being a part of the large training cycle, has a meaning only in connection with the overall preparation strategy in the framework of the large cycle.

- The choice of effective principles and a rational employment of the large training cycle must proceed from the creation of the necessary conditions for a long-term adaptation of the organism to specific intensive muscular work. The structure of the large training cycle must therefore guarantee the realization of the existing adaptation reserves and the improvement of these reserves to a new higher level.

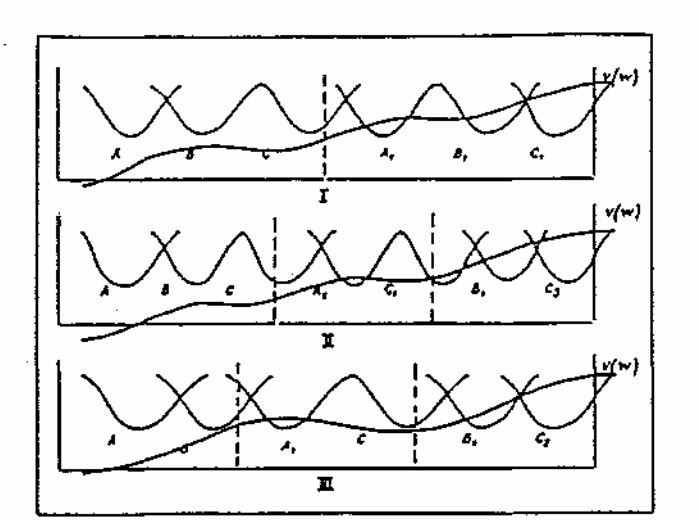

*FIG. 2: THE LARGE TRAINING CYCLE*
*The logical structure of the training system in the cycle*

There are two further principles to be considered:

*1. The realization of the specific effect of a training load.*

It is not only the potential of the training load, but also its quality, that is responsible for the training effect in the preparation of high performance athletes. In a complex situation with different direction loads the quality of the loads is expressed in a poor training effect and can even have a negative effect on other loads. For this reason it is advisable to use in the single phases of a large training cycle the so called single direction loads. From this follows that the specific training effect, besides the volume and the intensity, is a most important factor in the training process.

*2. The super-compensation of training loads with different single directions.*

This principle foresees a more intensive specific training effect for the adaptation areas that have been left behind by the previous loads. It must be stressed here that training loads with a different effect (Fig. 1, A, B, C) have no temporal limits. The training loads alternate or change their direction so that the preceding loads form a functional-morphological base for the training effect of the following loads. This solves the specific task to lift the adaptation level above the previous one.

In summary it can be said that:

- The effectiveness of the above outlined principles of the training organization has been confirmed in several experiments and studies in many events, including sprinting, hurdling, middle distance running and jumping.

- There are several ways to reach top performances. Consequently the discussed principles to prepare high performance athletes does not claim to be perfect, nor does it present monopoly in the methodology of training.

- The advantages of the large training cycle are in the possibility to observe the dynamics of an athlete's training state over a long time period and to search for rational ways to apply specific training loads in different microcycles.