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Challenge Decathlon – Barriers on the way to becoming the "King of Athletes" (Part I)

by Günter Tidow

ABSTRACT

The superior performance capacity of specialists in all disciplines of the decathlon as well as their rare double-representation in world ranking lists emphasise specialisation necessity for athletes. The analysis of the effects of this concentration on one single event reveals that the career path from raw talent to top class athlete is accompanied by or coincides with the development of a discipline-specific, subsystem partly incompatible with subsystems determining performance in other events. This is the main reason why even the best decathletes cannot fulfil the tenfold maximisation requirements inherent in the decathlon and why the ten-event grind is a unique challenge among all sports. Here, in Part I, the author presents the respective adaptations induced by specialisation, such as "movement centering", angle specificity in strength and flexibility, hypertrophy, hyperplasia, contractility and sense of balance.

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1 Introduction

The topic dealt with in this article was chosen to show the considerable barriers an athlete must overcome if he wants to fulfil the wide range of demands which are typical of the top-level decathlon. Once one is in possession of this information, it is easier to understand why there are clear limits to performance maximisation in the combined events even if potential world-record holders in arbitrary individual events change to the decathlon early enough.

The statement that combined events are more than their parts is by no means new. However, it is much more difficult to identify the reasons for this imbalance. The explanation that there is a continuous accumulation of fatigue, which is unavoidable in spite of the breaks between the individual disciplines, is certainly not sufficient. However, it is true that specialists have considerably better starting conditions in each discipline of the combined events. Although it seems to be quite normal today for television companies to dictate the Olympic timetable to an increasing extent, the finals of the 100 m or 110 m hurdles, for example, have not yet been scheduled at eight o'clock in the morning, which is a normal time decathletes have to cope with. In other words, even the performances in the first discipline of the decathlon cannot be directly compared with the specialists' performances, although at this stage of the competition the athletes are not fatigued at all.

However, in the minds of the sporting public, just these sorts of comparisons, which are caused by the international presentation of the combined-event athletes as "interval" individual-discipline competitors, are considered as the seemingly objective basis for the "correct" assessment of a decathlete's current objective performance capability at one glance. The additional disadvantage that he is given only three attempts in the long jump as well as in all the throws is simply ignored.

However, regardless of this distorted view - leading to the (superficial) conclusion that the decathlon is a "catchment basin" for the less gifted - one thing is correct: the specialists set the standards by which each combined-event athlete must be assessed as to the extent to which he has approached the ideal of perfection across the spectrum of events. However, this statement only applies if the transformation of the individual results into points, which is necessary for determining a winner precisely and objectively, and thus the scoring systems, reflects this reference basis (Ulbrich 1950; Tidow 1983b). Otherwise it could be no longer guaranteed that the best all-round athlete is the winner rather than merely the athlete whose individual performance capability best matches the characteristics of the scoring system. This is exactly the case with the current scoring tables of the IAAF, which were introduced in 1985 (Tidow 1989d). Beyond a certain point, the scoring system favours throwing and jumping performances and discriminates against sprinting performances of the same international standard. This situation undoubtedly has a bearing on talent selection and combined-events training and is demonstrated by a comparison of the development of the decathletes' relative performance ability in the individual decathlon disciplines.

It is a general fact that the superiority of the specialists varies considerably from discipline to discipline. For decades, as far as velocity is concerned, decathletes have come closest to the specialist level in the long jump and in the (hurdles) sprint (93%), while in the throws and in the 1500m decathletes are farthest away from the specialists (ca. 75%) (Tidow 1981c; Tidow 1989d). In Figure 1 the gaps between the ten decathletes with

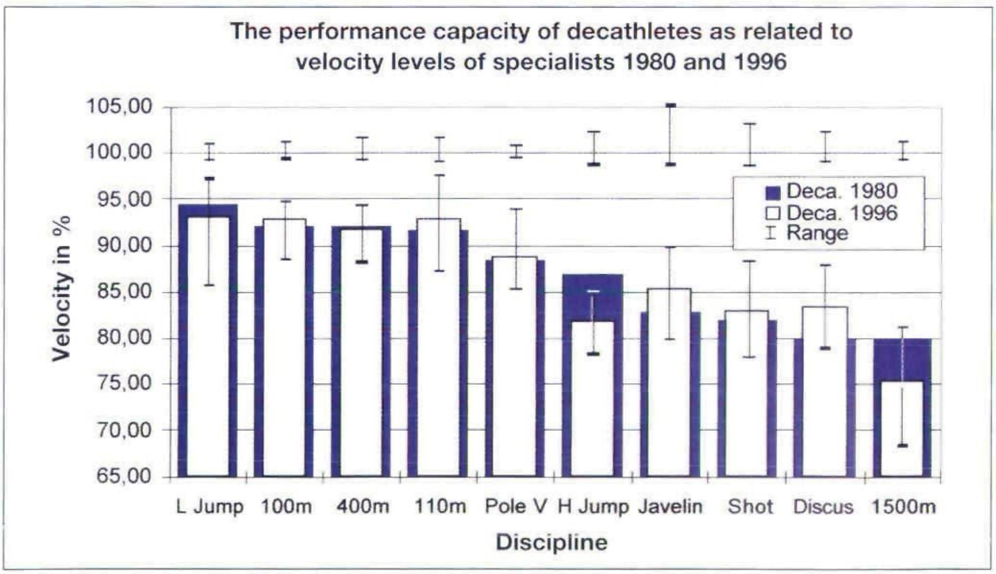


Figure 1: The average performance ability of the ten decathletes with the best point scores in 1980 and 1996 in relation to the levels of the ten best discipline specialists according to the world ranking list of the IAAF. In order to enable an interdisciplinary comparison between the times and distances or heights, the arithmetic mean values of performance have been converted into velocity mean values. The ranking order established for 1980 exhibits considerable discipline-specific differences. Although there is a fundamental parallelism, 16 years later there is a reduction in the gap between the decathletes and the specialists in the throws, while there is an increase in the difference for the high jump and 1500m. The vertical beams represent the velocity ranges of each discipline (for the modalities of computing the take-off and release velocities of the centre of gravity of the body or the throwing implement see: Tidow 1981c).

the highest scores and the ten best specialists in each event are presented in the form of velocity percentage values (mean velocity in the runs, take-off velocities in the jumps and release velocities in the throws). The comparison between 1980 and 1996 shows a far-reaching parallelism of the decline in the relative level of performance attained: The difference has become smaller in the throws, whereas it has become clearly bigger in the high jump as well as in the 1500m race.

The reduction of the performance gaps in the throws, including the shot put, might be caused by two primary factors: on the one hand stricter doping controls have reduced the average performance ability of the top throwers since the beginning of the nineties, on the other hand the above-mentioned influence of the scoring tables adopted in 1985 becomes noticeable. According to this system, throwing performances are scored progressively from a certain level of performance onwards. Correspondingly, at least some of the decathletes of the new generation with the best scores show certain strengths here – while hardly anyone shows striking weaknesses. The price of this is a reduced performance ability of the best decathletes in the 1500m and in the high jump, as compared with 1980, while there has been an increase in the performance level of the specialists. Consequently the developmental dynamics of the individual and combined-events athletes is characterised by a convergence in the throws and, in contrast to this, a divergence in the high jump and the 1500m.

When interpreting the performance gaps it must be taken into account that the arithmetic mean values are representative only for specialists competing in events with a very great performance density. In contrast to this, decathletes show a rather wide variation, so that in individual cases there are considerably greater or smaller distances to the specialist level (see vertical beams in the white columns of the decathletes in relation to the velocity ranges of the specialists on top of this). This implies that it is obviously possible to be successful in the decathlon with a quite different performance background. The resulting performance structure is the product of – possibly scoring-orientated – training and individual talent. This can be characterised by strengths, as for example in the sprinting, jumping or throwing disciplines, or it can be balanced (Joch 1969, 1973, 1975; Tidow 1981a, 1983a, 1988).

2 Prospects of success in athletics

When one analyses the world ranking lists as well as the results in the World Championships and Olympic Games, it becomes obvious that there are only few athletes who are successful at the highest level in more than one speed-strength event. Even where rare examples can be found they are virtually all restricted to the following combinations of two disciplines: 100m and long jump or shot put and discus throw. It is extremely rare to find athletes competing internationally in three disciplines at the same stage in their career.

The obvious conclusion is that specialists predominate, and there are no traces of true 'all-round athletes'. Thus, when looked at in more detail, athletics is a "collective sport" for a great number of individual competitors who, from an interdisciplinary point of view, have nothing more in common than the intention to surpass each other – and themselves. Of course this also applies to combined-event athletes. However, they are the only athletes who take up the challenge of competing across the whole range of athletics disciplines – unlike, for example, long jumpers, shot putters or middle distance runners – and are therefore the only true track and field athletes.

It seems to be remarkable that even with combined-event athletes very few discipline combinations exhibit a significant internal relationship: correlation-statistical analyses (Bäumler/Rieder 1972; Linden 1977; Kunz 1980; Joch 1981) unanimously show that these disciplines are identical with those where – as mentioned above – few specialists are placed in the world ranking lists (in decathletes there is additionally only the 'plausible' connection between the 100 and 400m, which is no attractive double start combination for specialists). This means that, as far as performance is concerned, the majority of the combined-event disciplines are independent from one another, as it were, even with those athletes who pursue the ideal of universality.

The question as to the causes of this necessity to specialise in one event in order to achieve top-level performances in athletics has as yet hardly been dealt with. However, giving an answer to this question seems to be the key for understanding why it is right to regard the "voluntary" grappling with ten disciplines as a permanent challenge.

This question can be approached by trying first of all to trace the determinants of success in the individual athletics disciplines. Everybody knows that without talent nothing is achieved! As far as content is concerned, this concept can be filled with four 'dimensions', the two pairs of which are connected at least to some extent (see **Figure 2**). Only the first pair is clearly visible and can be identified by the expert almost at first glance. The second pair of determinants, which most definitely decide performance in the end, remains in the dark to a great extent.

One speaks of a 'natural movement talent' when a young individual is either able to realise important elements of a target technique right away or when he or she needs only a small amount of instruction in order to be able to execute complex motor skills correctly. According to the current state of knowledge, such gifts are mainly based on the movement experiences an athlete has gained from early childhood by being offered a great variety of movement opportunities (Joch 1974; Tidow 1988).

When, in addition to this, the talented individual exhibits a great propelling capacity or flexibility which matches the mechanical or energetic requirements of the respective discipline, two of the four talent factors are fulfilled. Performance advantages are almost an automatic consequence of this.

To what extent a talented individual becomes a top-level athlete is almost exclusively dependent on untapped adaptation reserves in combination with a high load tolerance. When both prerequisites for development are fulfilled, that coach will be successful who links up with a permanently highly motivated athlete with the greatest adaptation reserves (and in whose coaching he makes only few mistakes).

The reason why this process is always exciting is that as yet there is no measuring instrument available which enables a reliable estimation of the potential for development lying dormant in an athlete. The amount of this potential is revealed only after years of training – if at all. This is the problem with all talent promotion programmes. (Contrary to this, success in the decathlon is neither dependent on extremely great adaptation reserves nor on their complete exploitation. Although this

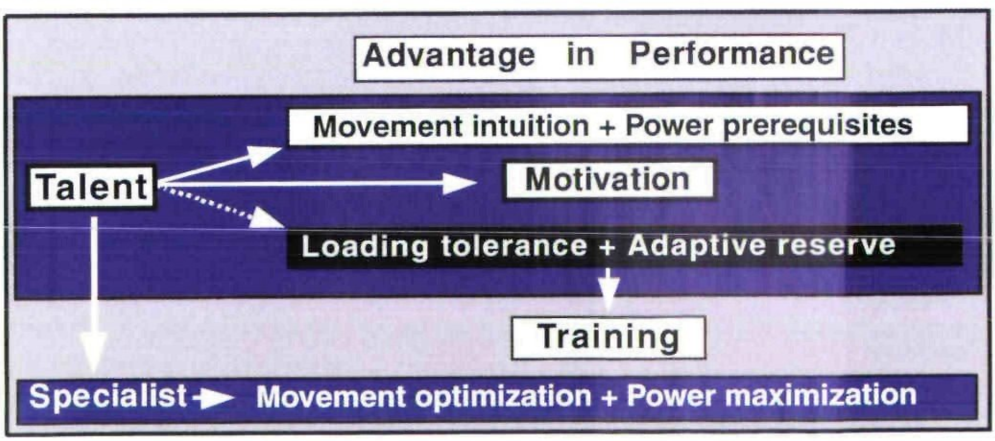


Figure 2: Primary factors influencing discipline-specific world-class performances in athletics

generally increases the chances of decathletes to be successful, the probability that an individual athlete is an "all-round competitor" with developmental possibilities in a variety of disciplines decreases in proportion with the required level of performance.)

3 Specialisation effects

It takes between five and ten years to attain world-class level in a certain discipline. Even if it seems far fetched to multiply this number of years by the number of the technical disciplines in order to determine the period of time which is necessary to produce a top-level decathlete, this is correct at least to the extent that the special talent can develop without being influenced by disturbing variables. In contrast to this, combined-event athletes, who must permanently deal with a lot of disciplines, are almost systematically hindered from specialising universally, so to speak. Quite bluntly, there is no possibility of a cumulative specialisation for a decathlete even if his physical, motor and technomotor preparation is distributed over many years in one discipline after the other. This is mainly caused by the fact that the motor system must bring the respective discipline-specific impulse patterns in line with the current driving conditions. It is very probable that the resulting refinement cannot be exchanged or called up at will at a certain point in time but can only be changed over a certain period of time in favour of one specific discipline at the expense of another discipline. How important an undisturbed time of development in one discipline is for an optimal exploitation of talent can be shown with different phenomena, which can be tracked down in specialists.

3.1 Co-ordination: "Movement centring"

When, in the world-best specialists, the ranges of time measured in those disciplines of the decathlon which are limited by speed-strength are analysed, it becomes obvious that in the respective core phases of force transmission - to the body or to the implement - not more than 100msec are available (see **Figure 3**). In all eight disciplines the goal is an absolute maximisation of velocity. To this end the motor system uses ballistic movements (Tidow 1982). Such actions, which are the fastest that a human being is capable of, take place in a pre-programmed way. When they have been activated, it is

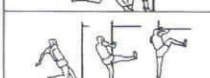
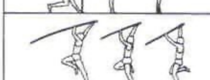
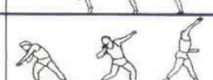
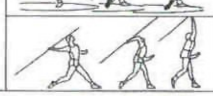
Reference	Discipline	Duration	V	V_0
		160/340 ms	-	3 m/s
Sprints		80 ms	12.1 m/s	-
		120/75 ms	9.3 m/s	-
		120 ms	10-11 m/s	10 m/s
Jumps		140 ms	7-8 m/s	5.5 m/s
		240 ms	5-8 m/s	5 m/s
		120 ms	8.8-9.7 m/s	-
		270/<100 ms	3 m/s	14.3 m/s
Throws		250/<100 ms	-	26.5 m/s
		300/<100 ms	6-8 m/s	32 m/s

Figure 3: The ranges of duration and velocity maxima in the core phases of the decathlon disciplines limited by speed. The performance data is those of world-best specialists. While in the sprints and jumps the ground contact times can be used for force transmission so that the leg and hip extensors function as primary and final kinetors (= movement creators) at the same time, there is an upward directed acceleration chain in the throws, in which the leg, trunk and finally the throwing/putting arm muscles are activated successively. For the latter muscles about 100msec are available for impulse transmission.

not possible to correct them during the execution. This applies even if the athlete – in spite of the extremely short duration and complexity of the movement – should have been able to discover such a deviation in a split-second because of his sharpened movement awareness. Consequently, if there is a programme error, an attempt at deleting this error can only take place after the result. How fast (or slowly) a necessary change of the programme can be translated into practice is primarily dependent on the degree of automation. Experience teaches that the older and more firmly established the respective impulse pattern is, the more resistant it is to correction.

With the movement tasks included in the sprinting, jumping and throwing disciplines only achievable by using the gross motor system, the goal to reach maximum velocities leads, firstly, to an optimal intermuscular co-ordination of the partial impulses in relation to time and, secondly, to a maximum intramuscular time related activation of the terminal accelerators.

The main reason why this is only possible in an individual in a specific discipline instead of in all disciplines is that the movement tasks differ from one another. In the sprint, for example, the athlete has the task to integrate the swinging elements into the push-off, to ensure force transmission through the stabilisation of the trunk and to create the best working conditions for the respective agonists and optimally long micro-regeneration phases for the respective antagonists through the maximally fast alternation of tension and relaxation. Just as with the jumps and throws, this takes place under enormous time pressure because, in the respective core phases, the athlete's body (or the implement) is already in (very fast) movement caused by pre-acceleration.

A consequence of this is that in the sprinting, jumping and throwing disciplines there are no stationary strength efforts, as for example in the tennis serve. Neither can track and field athletes make use of a second chance, comparable to the second serve available to tennis players, because of the requirement of maximisation. A reduction in velocity by 10 to 15%, which is typical of the second serve in tennis, would lead to more than poor results in the throws – with a loss of distance of about 4m (in the shot put) or up to 20m (in the javelin throw)! In other words: In the speed-strength disciplines of athletics the securing of an attempt through a decrease in intensity, which is inconspicuous and rather normal in non-cgs sports, would lead to differences which would neutralise the performance advantage of the best specialists in the world over the decathletes with the best scores (see **Figure 1**: the difference of 15% in the release velocity of the javelin corresponds with a difference in distance of 24m – i.e. the difference between 89 and 65m).

In trying to find a balance of the career of a world-class thrower or jumper, all the technically relevant kinetors (= movement creators) need to be taken to an increasingly higher level of performance through above-threshold strength training loads being repeated periodically until the adaptation reserves are more or less exploited. By executing the target technique repetitively many thousands of times, the kinetors are matched with and adjusted to one another to transform acquired strength into movement speed maxima. This "centring of movement", which sometimes takes more than ten years requires a neuronal programme predominance, which includes the muscle spindles and is often associated with a restriction in the scope of the muscular action. Such effects of specialisation become apparent if one persuades world-class athletes to start (again) in disciplines which they were good at from a technomotor point of view when they were young. In most of these athletes there is then a considerable gap between the extreme muscular potential and the (modest) result achieved on this basis.

3.2 Strength and flexibility: Angle specificity

When one analyses the working angles which are existent in the core phases of each combined-event discipline (e.g. in the knee joint of the take-off leg, the elbow joint of the throwing arm or as related to the trunk torque), there are rarely congruities. Added to this is the fact that the working conditions - especially as far as dynamics is concerned - are not identical. Therefore, an interdisciplinary synopsis of the statically represented front support and rear support phases in the sprint and jumps as well as of the release positions can confirm this finding only indirectly (see **Figures 4, 5, 6**). In comparing, for example, the run-up velocities in the long and high jump, which differ by up to 4m/sec, it is quite obvious that the long jump take-off leg is loaded "in a different way" than in the high jump, regardless of the bracing angle.

Taking into account a certain movement affinity between the shot put and the discus throw (Kunz 1984), these differences can be interpreted to the extent that, for the creation of an optimal acceleration impulse, at least three requirements must be fulfilled from a discipline-specific point of view:

- First of all, the muscle fibre lengths of the motor units must guarantee the highest mechanical efficiency through an optimal amount of overlapping of the actin and myosin filaments.
- Secondly, a correctly timed maximum activation of the driving muscles.
- Thirdly, a corresponding optimally timed deactivation of the antagonists.

Apart from these demands made on the target muscles (and their respective antagonists), corresponding demands apply to the postural muscles, too. Experiments show that the degree of neuronal activation (of a flexor or extensor) co-varies with the angular position of the joint and moves towards a maximum within a certain - small - angular zone. Should the situation occur that, during muscle contractions for a period of several weeks, a different angular position is isometrically pre-determined, the maximum activation - which can be quantified using EMG analysis - moves in the direction of the training position (Thepaut-Mathieu et al. 1988). At the same time there is a change of that angular position of the joint, where the maximum angular momentum is produced. It must be assumed as a hypothesis that these results

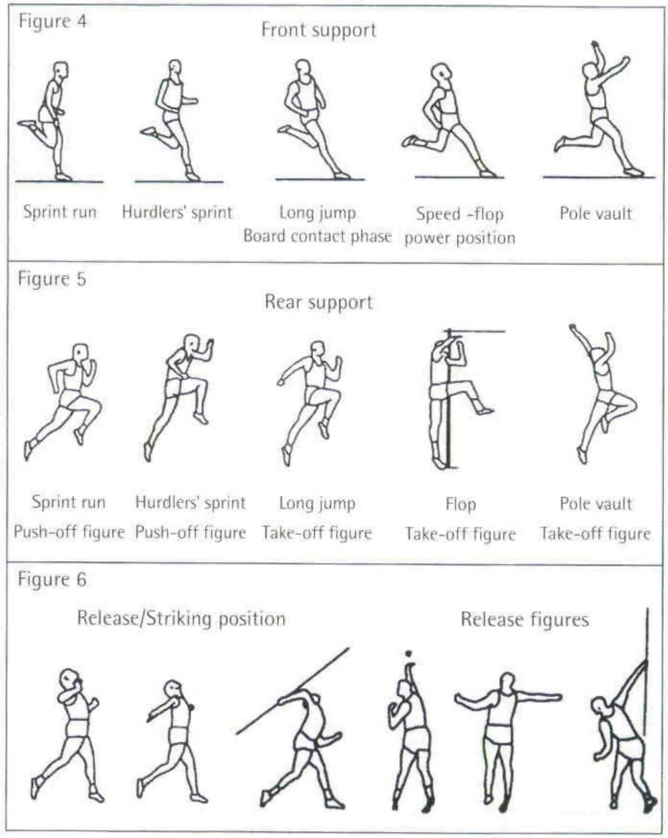


Figure 4 (at the top), Figure 5 (centre), and Figure 6 (at the bottom): Interdisciplinary comparison of the front support and rear support phases in the sprinting and jumping disciplines of the decathlon. A practical example are the identifiable, though small, variations between the angles of the knee joint at the touchdown in the front support position or the divergence in trunk position (forward lean or backward lean), which imply varying working conditions. In the throw, the close movement affinity between the shot put and the discus throw (and the small affinity to the javelin throw) becomes apparent from the side view. From the rear view the comparative analysis of the release proves a certain independence, particularly regarding the alignment of the shoulder axis and the trunk. (The Figures show some of the best specialists.)

are based on two adaptive mechanisms: in terms of the neuronal system, every contraction command not only includes excitatory but also inhibitory impulses. Against this background, the angular specificity is based on the fact that during the activation of the respective flexors/extensors in everyday (habitual) angular positions of the joint, a large amount of the neural drive reaches the motor end-plates without inhibition. However, in rather unfamiliar angular positions (which are normally not used to create maximum forces) there is a stronger inhibition. The adaptive reserve in the area of muscle mechanics consists of the adjustment of the fibre length and thus the optimal degree of overlapping in such a way that the greatest angular momentum or the greatest active tension is reached in a position which is normally characterised by the highest strength demands (Herring et al. 1984).

It has already been mentioned that these strength demands resemble each other only to some extent - if at all. Correspondingly, in terms of time, it is not possible for a driving mechanism to exist which is equally optimal or which can provide an identical maximum neural activation for all disciplines. From a neuromuscular point of view, the term 'special strength', which is often used in athletics, can be attributed to the adaptation mechanisms mentioned here.

3.3 Laterality: Hypertrophy, hyperplasia, contractility

Lateral preferences imply that in the motor context all human beings are specialised by nature, so to speak. The lifelong preference for one extremity - e.g. the right arm or the left leg - as well as a predilection for a certain direction when turning around or rotating about one's longitudinal axis, which gets steadily firmer from childhood onwards, eventually leads to a more or less marked muscular asymmetry, which can even be osseous in competitive athletes.

It has, for example, been demonstrated by autopsies that the muscles of the right lower arm in right-handers exhibit a fibre transformation: According to Fugl-Meyer et al. (1982) there are significantly more slow-twitch fibres in the dominant arm implying a higher fatigue resistance. Probably induced by the abutment function of the contralateral left leg, certain muscle groups of the lower left leg show a greater population of fibres in right-handers indicating hyperplasia (Sjöström et al. 1991). Applying planimetric magnetic resonance imaging of the trunk muscles of 122 trainees (average age: 18 years), we ourselves could demonstrate that the left side of the body of the right-handers (n=112) showed a significantly greater cross-sectional area (Tidow et al. 1997). This finding seems even more remarkable because there were no competitive athletes among the people examined. In individual cases the difference was as much as 14%. When one considers that carrying loads with the preferred hand means a stress on the arm muscles of the same side and a simultaneous activation of the contra-lateral trunk muscles for the stabilisation of one's balance, these functional asymmetries become plausible.

The results of the measurements of leg lengths in Scandinavian track and field athletes of various disciplines - 63 jumpers and 86 runners - are more surprising (cf. Friberg/Kvist 1988). According to these measurements, 69% of all long and high jumpers had a take-off leg which was 0.5 - 2.5cm longer than the other leg. In contrast to this, in sprinters the leg length difference was much less pronounced if existent at all (which was the case in 19%). While the mechanical advantage of a longer take-off leg is obvious, it is more problematic to relate cause and effect to one another as far as time is concerned. The question is whether the higher stress which had been placed on the take-off leg over a period of many years had eventually induced an osseous adaptation - as is typical of top-level tennis players as far as their playing arm is concerned - or whether intuitively the respectively longer leg had been chosen as the take-off leg.

Furthermore, it is remarkable that when testing muscular contractility by means of electrostimulation it could be verified that, for example, hurdlers as well as high jumpers and pole vaulters exhibit a higher muscle contractility in their swing leg than in their take-off leg (cf. Absaljamow et al. 1976). Here the authors assume that the decrease in contractility was caused by the higher mechanical load. In animal experiments Caiozzo et al. (1992) used above-threshold strength training of one leg to induce an analogous, highly significant left transformation in the fibre spectrum of the fast running muscles, which occurred only in the target leg.

3.4 Sense of balance: Habituation

Body posture, orientation in space and direction stability are controlled by the vestibular system. Feelings of dizziness occurring directly after rotations indicate that this organ is very sensitive to higher accelerations and affects the support-motor system with decreasing intensity (Bartmus 1987; Neumann 1991). Although correct body posture, orientation within the space of the throwing circle, and stability of direction as related to the throwing sector are elementary requirements for a technically acceptable discus throw, the $1^1/_2$ turns preparing for the release do not cause feelings of dizziness in anybody.

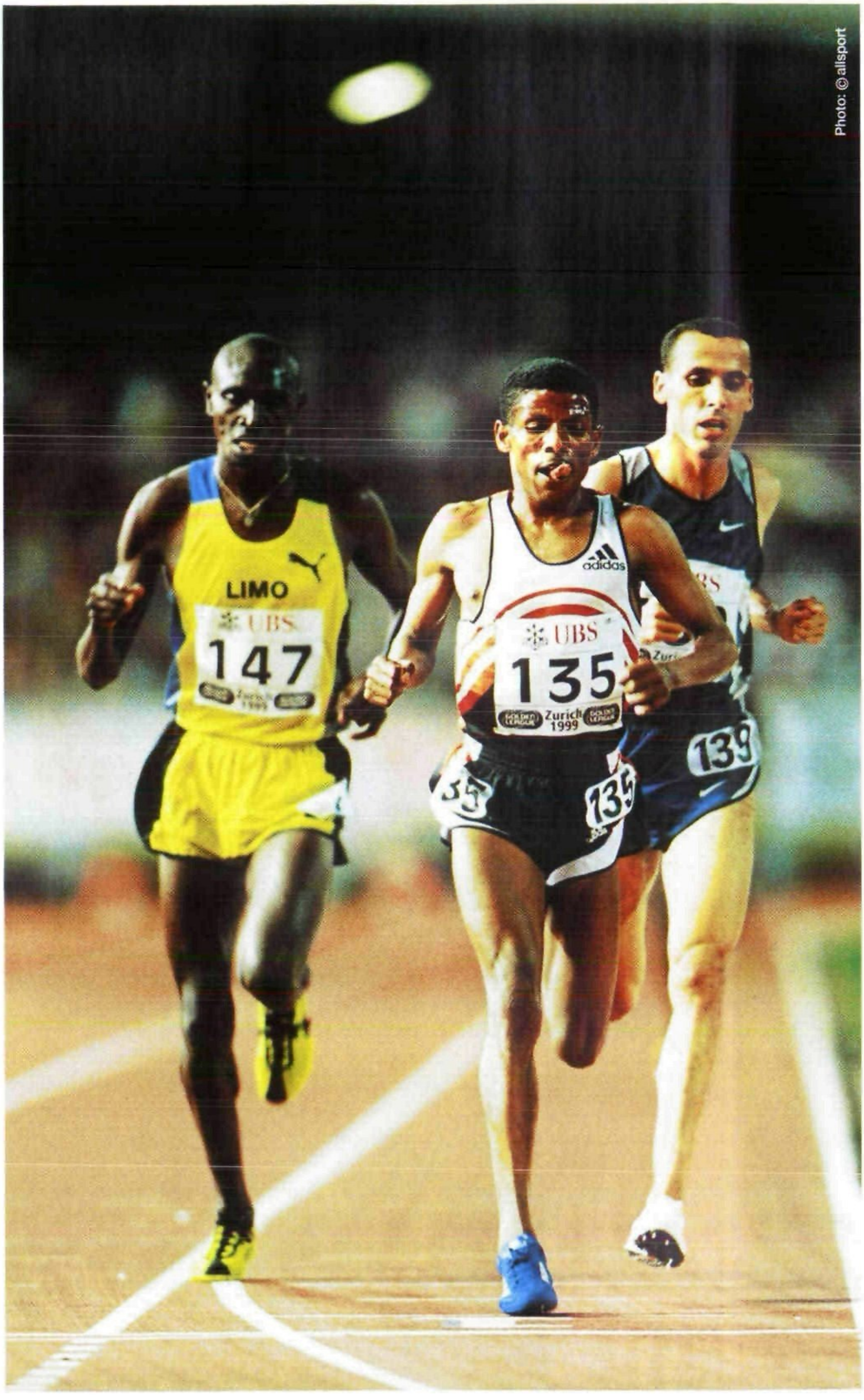
This is probably the reason why for a long time both coaches and athletes have underestimated the significance of a sense of balance which is immune against rotations. To what extent this statement is justified in individual cases can be clarified quickly by using a simple test. The athlete touches a men's shot lying on the ground with the tips of the hand of his swinging arm and, while maintaining this contact, he runs around the shot as fast as he can ten times to the left (right-handers) or to the right (left-handers). Right after this, he is told to walk a distance of 10m along a line. If he succeeds in this, an untrained sense of balance can be ruled out as the cause of demonstrated, hard to correct technical deficits in the discus throw. However, studies which we have conducted with a great number of young decathletes show that none of them was able to fulfil the actual test task – walking along the line – even to some extent. They would have fallen to the ground in a completely uncontrollable manner if they had not been caught by companions who had been positioned precisely for this purpose. Unlike the decathletes, the specialists were not only able to walk along the line but they could even run along it – and afterwards they asked what the problem was ...

In special terminology this phenomenon of an indifference towards rotary accelerations is called habituation. In common with other adaptive phenomena however, this habituation, too, is not stable and permanently effective but reversible. Once the athlete lays off executing the rotary movement for a few weeks, his sensitivity will increase again, which means that the rotation will lead to an impaired equilibrium.

Local conditions during the preparatory period hinder most decathletes from throwing the discus with a full turn, so almost no stress is placed on their vestibular system as far as rotations about the longitudinal axis are concerned for a period of up to six months. Correspondingly, each year the same insecurities in the throwing circle are preprogrammed. In addition to this, an athlete training by throwing implements in series – for example five consecutive throws – will bring about a serial, unconscious increase in the load placed on the vestibular system because by each consecutive trial a new stimulus is set within the abating phase. The same is the case when during the preparation for competition (in the decathlon) a maximum number of warm-up attempts is executed one after the other as fast as possible.

Against this background, the increasing frequency of movement faults and the simultaneously decreasing possibility of correction in the same discus technique training session can be explained. By now the remedy is known to everybody: Rotations about the longitudinal axis with and without implements which closely resemble the throwing technique and which are optimally executed along the lines on the track are a part of the standard warm-up repertoire of decathletes all through the year. This way it is possible to avoid rotation-induced irritations of one's equilibrium. Consequently, at least as far as this aspect is concerned, the specialists can no longer claim to be at a notable advantage. ■

To be continued in NSA 3/4 2000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