NSA ROUND TABLE

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This edition of the Round Table examines the horizontal jumps. The multi-national panel consists of five of our regular contributors Jim Alford (GBR), José Manuel Ballesteros (ESP), Li Chengzhi (CHN), Frank Dick (GBR) and Vern Gambetta.

They are joined by new Advisory Editorial Board member Jess Jarver (AUS), Dr James Hay (USA), who is Head of the Biomechanics Programme in the Department of Exercise Science at the University of Iowa, USA, Dan Pfaff (USA), who is the jumps and combined events coach at Louisiana State University, USA and Lyle Sanderson (CAN), who is the Head Coach at the University of Saskatchewan, Canada and the National Training Centre in Saskatoon, Canada

1 What are your views on the most effective methods of obtaining optimum height/take-off angle with minimal loss of horizontal velocity in the long jump?

ALFORD: I think it is generally unproductive to emphasize the 'preparation' for take-off, firstly because this frequently leads to a loss of horizontal velocity and, secondly, because I feel that the modifications to their running action displayed by the top jumpers are often natural to the individual.

I have found it most effective:
a) to work on giving the athlete the 'feel' of an efficient take-off posture, which gives optimum lift from the arms, the free leg and the take-off leg drive. A variety of methods should be used for this, e.g. manual static placement on the take off board, demonstrations, explanations, video etc.
b) to give plenty of practice of going through this position and trying to 'explode' from the board and
c) finally, to work on the rhythm of the last 5 strides before take-off (which is somewhat similar to that of the Javelin approach and throw)

BALLESTEROS: Optimum values may be achieved either through good technique or specific preparation work. In the first instance, it may be achieved by using the the 'sinking' formula with a slight increase in the length of the last stride, but without a loss of speed (as in the case of Beamon). But this is very difficult if the athlete does not have an extraordinarily strong build.

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In the second instance, optimum values may be achieved by doing a lot of elastic reactive strength work (plyometrics). Vertical force of approximately 4 m/s and an approach speed of approximately 11 m/s should be considered as ideal values.

CHENGZHI: Emphasise active use of the body segments, i.e. arms and free leg to assist the strong extension drive from the take-off leg.

DICK: I think you must emphasise the *early* and *fast* lift of the free thigh into take-off. This should not be seen as a powerful and strong movement by the athlete – otherwise the timing will not be correct and the action will contribute to braking forces. Rather it should be seen as a 'light' and fast movement.

This approach should be built on a foundation of jumping leg work which mixes powerful extension for lift, with fast touch-off for speed of response on planting the take-off foot.

GAMBETTA: A well programmed approach run that is reliable regardless of the climatic conditions. This demands constant practice on the full approach with an emphasis on a smooth pattern of acceleration and correct rhythm over the last four to six strides.

HAY: Research has provided some clear indications as to how to achieve this goal. It shows that elite men and women jumpers make little adjustment in their body position in preparation for take-off until near the end of the second-last stride of the approach. When the (non take-off) foot touches down at the end of this stride, the centre of gravity of the body is about 3-5cm lower and the foot about 4-8cm farther forward, than at the corresponding stage in the previous strides. They stay low during the remainder of the support phase, and drive low (and with an incomplete extension of the driving leg) into the take-off of the last stride. The flight phase of the last stride is brief in duration and short in length and ends with the centre of gravity still low and the take-off foot some 70-80cm forward of the centre of gravity at the instant of touch-down. From this position, and with a minimal bending of the knee of the take-off leg, they rotate forward and drive up into the take-off to the jump.

JARVER: The aim of achieving an optimum take-off angle with minimal velocity losses depends largely on individual

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performance capacities and the athlete's ability to adapt technique to these. Nevertheless, it appears that the majority of long jumpers attempt to achieve this task by a slightly lengthening of the penultimate stride to lower the centre of gravity in order to achieve a longer path of acceleration and to catch the centre of gravity on its upward path at the take-off.

The changes in the transition from the run-up to the take-off phase are less marked in jumpers with a high sprinting speed, although, naturally, there are exceptions. Some sprinter type athletes have an elongated penultimate stride with an early lowering of the centre of mass, while some jumper types shorten the penultimate stride.

Whatever the case, the last stride must be executed fast and without lowering the centre of gravity in order to cut velocity losses to a minimum.

PFAFF: Optimum height of the athlete's centre of mass and the related take-off angle are directly correlated to that individual's ability to lower the centre of mass during the preceding stride. This lowering also establishes a superior elastic-reflexive response if horizontal velocity losses are kept to a minimum. Horizontal velocity losses can be generally attributed to faulty posture, inferior foot contact/centre of mass relationships, and drastic rhythm disturbances. An athlete with excessive forward or backward lean during the last three steps will radically affect both of the qualities addressed in this question. Foot contact too far ahead of an athlete's centre of mass creates harmful braking forces while contact to the rear will cause noticable forward rotation. Radical stride rhythm changes during the lowering and resultant take-off movements creates problems with neuromuscular coordination.

SANDERSON: The biomechanical research carried out at recent World Championships and Olympic Games indicates that there is considerable variation in angle of take-off among the world's top long jumpers. The angle of take-off is a result of the relationship between the horizontal velocity at which the jumper's centre of mass is travelling and the vertical force exerted as the centre of mass passes over the take-off foot. Any increase in horizontal velocity results in a corresponding increase in the vertical force required to achieve the same take-off angle. In addition, increased horizontal velocity allows the jumper less time to exert vertical force since the centre of mass passes over the take-off foot in a shorter time.

In order to achieve maximum vertical force in the very short time that the jumper's foot is in contact with the board, the athlete must possess a high degree of specific strength. Recent research carried out by Dr. Carmelo Bosco indicates that there is a relationship between the contact time involved in the jumping drills carried out in training and the ability to exert force in a short time. He concludes that the best training effect is achieved when the contact times in training are similar to the contact time used in execution of the event. In order to achieve the optimum physical preparation to exert maximum vertical force in the very short time that the take-off foot is in contact with the board, the long jumper's training must be designed to emphasize jumping activities that require a short (competition type from full approach) ground contact time.

The technique a jumper uses when he makes contact with the board also affects the take-off angle. Video evidence of Mike Powell's world record jump shows that the knee of the take-off leg is bent very little when the foot contacts the board indicating that extension of the ankle joint must be a major factor in providing the vertical force. In addition, Powell's foot is quite far in front of his centre of mass and he then pulls it back just prior to contacting the board. The action is similar to the active landing of a triple jumper. This results in the centre of mass travelling through a greater distance while passing over the take-off without 'blocking' and losing horizontal velocity.

2 What methods have you found most successful in developing an accurate foot placement on the take-off board for the horizontal jumps?

ALFORD: I have always found this a difficult problem. The jumpers with the greatest speed and elastic strength are quite often the most irregular in their approach run (for example, Beamon). The most effective method I have found is to work up from a very short run up (4 strides), through 6, 8, 10 and eventually to 14 to 16 strides) over a period of several months, insisting on extreme accuracy on the take-off board from the very beginning, so that the athletes are practising spatial perception from the word go. To help further develop this ability I also use practices of jumps with varying lengths of run up.

At one time I used a check mark about 5-7 strides out from the board but, with varying amounts of success.

BALLESTEROS: Dividing the approach into three phases so as to better control foot placement on the take-off board. The first phase (6-8 strides) of acceleration develops the rhythm of the approach. The middle phase (the longest) is

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one of maximum speed and stride length. The final phase is made up of the last 6 steps whose dimensions should always be the same and rigorously controlled to ensure accurate foot placement on the take-off board.

CHENGZHI: I insist on strict regularity in the approach and use of check-marks for the first, third, fourth and the fourth before last steps of the approach.

DICK: Having established a basic approach run distance for the athlete, coaches must accept that there are a host of variables which will interfere with stride length and approach run consistency! Consequently, the athlete must be given opportunities to adjust/adapt to changes. On the one hand, coaches should try to develop the athlete's spatial awareness; on the other, they should try to develop the athlete's physical capacities to adjust stride lengths so that he or she can still hit the board – whilst making no compromises on speed. Hurdle work with fixed then mixed spacings; games where there are variable approaches to jumping – such as basketball; changing the approach run distance by up to 1m in training; and games where the athlete must move at speed whilst adjusting direction etc. changes *in the competition situation* are the best situations for learning.

GAMBETTA: A system of check marks to insure the accuracy of the strides. There should be a check mark two strides (four steps) into the approach run. It has been my experience that the first four steps are the most variable. Therefore, by controlling these strides with a starting check mark and a four step check mark the margin of error (which will be magnified at the take-off board) can be significantly reduced. In addition, there should be a coach's check mark four strides from the board which should be used to check the pattern of the last four strides. The athlete should not be aware. This check mark will provide valuable feed back based on the following scenarios:

a) If the jumper is on the check mark and over the board then the jumper is lengthening the last strides.
b) If the jumper is on the check mark and behind the take-off board then the jumper is shortening the last strides.
c) If the jumper is over or behind the coach's check mark and over or behind the board by the same distance then the first two check marks should be adjusted accordingly.

HAY: The accuracy of the approach depends on:
a) appropriate adjustment of the starting mark to allow for the conditions on the day.

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b) the consistency of the athlete's striding pattern from the start mark to the board and, assuming this is not perfectly consistent:
c) modification of the lengths of the final strides of the approach to obtain an accurate placement of the take-off foot on the board.

The first of these depends on intelligent observation of the effects of varying conditions and the second on frequent and thoughtful practise of the approach run. From my observation, athletes and coaches pay little serious attention to the first and, as a consequence, often have problems establishing an appropriate start mark prior to a competition. They also tend to spend less time than is necessary to develop and maintain a consistent striding pattern to the board. And this tendency is by no means limited to athletes of modest accomplishment. Some of the world's finest horizontal jumpers have very inconsistent striding patterns because they fail to devote sufficient time and effort to this end. Finally, only a few athletes, in my experience, devote time to developing the ability to zero-in on the board during the final strides of the approach, without compromising their forward speed. Two drills are worth considering for this purpose – short and long approach runs (with a take-off) from deliberately and systematically-misplaced positions of the start mark, and sprints over very low hurdles placed at irregular intervals.

JARVER: None in particular. Long jumpers have to develop their own run-up rhythm and precision that is adapted to their performance capacities and continually repeated. Check marks can be sometimes helpful, but experienced athletes have usually a well established sense of distance and really do not need them.

When it comes to the development of spatial judgement, less experienced athletes, who have trouble with frequent fouling, can often benefit from looking at one corner of the take-off board in the final stages of the approach run. This increases the visual distance slightly in comparison to a straight ahead look.

PFAFF: In light of the research coming out of Dr James Hay's laboratory in Iowa, I think one has to address an athlete's ablity to 'steer' towards an accurate foot placement on the board. Doing approach work on a variety of surfaces under as many changing environment conditions (wind, wet, cool, altitude etc) as possible assists in this area. The Rawson method, as addressed in Schmolinsky's *Track and*

Field text, has been quite useful both on full run approach work and during short run jump training. Approach work with emphasis on preparation for take-off combined with a modified take-off can also increase high speed accuracy. It has been my experience that, as an athlete's ability to run correctly improves and he keeps those qualities in order as he prepares for take-off, accuracy improves also. Novices who undergo radical movements and large rhythm disturbances as they set up the take-off are noticeably less accurate. Recent research on peripheral vision tracking by leading sport science researchers may make a difference in future to this always challenging technical dilemma.

SANDERSON: The approach must be practised under conditions similar to those experienced in competition. The athlete must run with the same technique each time and take-off on each approach. Adequate recovery must be allowed between each practice trial to simulate competitive conditions.

The coach must also take the athlete's personal characteristics into account. One of the better jumpers I have worked with tended to increase her stride length with each trial of the competition. This problem was solved by moving her starting mark back 10cm after each trial.

An improvement in physical condition and speed on the runway will sometimes lead to the jumper fouling on almost every jump no matter how much the starting mark is moved back. The jumpers perception of where the foot will contact the ground is based on the experience of a former shorter stride length that was present prior to the improvement in condition. In training, I ask the jumper to show me where he/she thinks that the foot was on the board after each jump. I then show him/her where the foot actually was. Over time, the athlete's perception will change to be in line with his/her new stride pattern. In extreme cases, I ask the athlete to concentrate on hitting the middle or even the back of the board.

3 Have you any definite views on the best way to begin the run-up for the horizontal jumps?

ALFORD: The really important thing, of course, is extreme accuracy and regularity of the movements, both at the beginning of the run-up and for the whole length of it, so that the jumper can hit the board accurately and take-off with optimum horizontal and vertical velocity. But I think there are several ways of beginning the run up which can achieve this. The 'standing start' with maximum acceleration type of run up, I suppose, could give greatest accuracy

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but most athletes do not like to dissipate as much energy to get to the take-off. I think the method used by Mike Powell (and Willie Banks in the triple) of a very stylised and regular walk on to a check mark and then smooth acceleration to the board is as good as any.

BALLESTEROS: Walking a few steps prior to the approach run (Mike Powell) allows greater relaxation during the approach, but less chance of hitting the take-off board accurately. Starting the approach run with maximum effort is a way of ensuring a better acceleration. Starting from a standing start allows greater regularity in the approach to the board

CHENGZHI: Take up a position with one foot in front of the other and then start off with a few slow running or walking strides.

DICK: Whatever the athlete is comfortable and consistent with.

HAY: To the best of my knowledge, no research has yet been conducted on the influence that 'starting technique' has on the subsequent performance. Further, I have heard no convincing argument in support of the rolling starts so frequently observed. I favour instead a simple standing start with a minimum of choreography. There may be no cause-effect relationship involved, but it is interesting to note that pole vaulters have much more consistent striding patterns than horizontal jumpers and most of them use a simple standing start.

JARVER: None. Idiosyncrasies at the begin of the run-up are common. Although not really recommendable, there is no harm done when the run-up is always started exactly in the same manner and follows the accustomed acceleration pattern. Deviations spell trouble and should be avoided.

GAMBETTA: Count the number of times that the take-off foot contacts the ground. Begin with six steps and progress in two step increments until the athlete is at the full approach distance usually twenty to twenty two steps. Repetitively practise the approach run on a track away from the runway without the take-off board as a frame of reference.

PFAFF: I favour a stationary, staggered starting position-with foot spacing almost identical to the athlete's block spacing for the sprint start. The mechanics, posture and

rhythm are the same as those of our training programme's standing sprint start and taught in the same way. This format encourages a controlled, uniform acceleration pattern that is quite efficient in terms of neuromuscular conservation.

SANDERSON: The run-up must begin exactly the same way on each approach. I favour a measured two step walk on to the start mark. This gives the jumper the same starting horizontal velocity each time.

4 Do you consider that a 'double' arm action is a viable proposition for the take-off for the first (Hop) phase in the triple jump?

ALFORD: No. If it were viable for the hop in the triple jumps, it would be viable for the long jump take-off, but that it is not! I believe it is bound to detract substantially from the horizontal velocity built up in the run-up and it is not difficult to get sufficient height in the hop using an alternate arm action. In any case, most triple jumpers try not to get too much height in the first phase.

BALLESTEROS: Use of the double arm action in the hop phase leads to a loss of speed in the preparation for take-off and this loss is greater than any help that such an action (with its doubling of forces) might provide.

DICK: No. Because it detracts from forward momentum/speed.

HAY: Like most other observers of the triple jump, I have seen many athletes attempt to use a double-arm action off the board. The usual result is a weak, abbreviated action that appears to contribute little to the forward or upward motion of the athlete. In addition, the athlete's preparation for the double-arm action during the final strides of the approach might have an adverse effect on his (or her) horizontal velocity – as has often been claimed. In the absence of research or obvious practical evidence of its value, I would not recommend use of a double-arm action.

JARVER: Excellent performances by some athletes appear to indicate that a double arm action is viable, although there are no apparent advantages for this action from a biomechanical viewpoint. A shift to a double arm take-off should be considered viable only when it occurs at the actual take-off and not during the last two strides of the run-up. The last would result in a reduction of the all important horizontal velocity. As there appear to be no advantages in the double arm action, the normal alternate single arm action is definitely preferable.

GAMBETTA: I have always felt that the double arm action in the hop take-off compromises the horizontal velocity in the next two phases. In teaching beginners and emerging athletes I prefer a single arm 'natural' arm action for the hop phase followed by a double arm take-off in the next two phases.

PFAFF: I think a double arm variation during the hop phase can be quite efficient so long as it is not initiated too early during the take-off mechanism. The horizontal velocity losses and postural ramifications of premature or radical arm withdrawal have to be evaluated when deciding whether to use, modify, or discard this style.

SANDERSON: The triple jumper does not require a great deal of vertical force to achieve an optimum take-off angle for the hop phase. Preparation for a double arm action prior to the take-off for the hop phase will lead to a loss of horizontal velocity. I feel that a double arm action for the take-off for the first (hop) phase will result in a greater loss due to decreased horizontal velocity than can be gained by increased ground forces.

5 From your experience (or observation) of the *women's triple jump*, what differences have you noted, in technique or in training methods, between the women's and the men's event?

ALFORD: Like the other athletic events the only difference I can see is in the distances achieved.

BALLESTEROS: Technically, women should aim for a lesser flexing of the knee (this lesser load allows a faster action of the take-off leg) and to position the hip over the point of support. The proportion of total distance covered in each phase also shows certain differences between men and women. With regards training, the work of making athletes more powerful is even more necessary for women than it is for men. For example, to achieve a similar application of force, women should use greater heights in plyometric training (their body load is less so this is not as dangerous as it may seem) and they can achieve greater reactivity.

DICK: Any differences seen have been restricted to the foundation of conditioning which women have compared with men. Once women have been given the opportunity to develop such a foundation, I can see little difference with regards training and technique except in the generally accepted reduction in jumping related exercises in the premenstrual 2-3 days.

HAY: In my view, this is not a particularly useful question – even though it is asked quite frequently. It implies an ability

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to define a men's and women's technique. (I will confine myself here to techniques, because these are far more readily observed than training methods). We cannot usefully compare two things if we cannot first define what these things are. For example, what are the characteristics of the men's triple jump technique?

The truth of the matter is that the techniques used by the men are so highly variable as to make the definition of a representative technique either meaningless of impossible. consider, for example, the distribution of effort over the three phases. Is the men's technique appropriately represented by the massive hop and lesser step and jump used by Harrison, Markov and Hoffman, or rather by the greater jump phase of Conley, Banks and de Oliveira? Even if one finds an appropriate way to define the men's (and the women's!) technique, one must then eliminate the influence of differences in level of ability before a useful comparison can be made. If this is not done, any differences in technique that one might observe (for example, between women jumping 14-15m and men jumping 17-18m) may have nothing to do with differences in gender. They may be entirely due to differences in ability. Or, to put it another way, these differences may cease to exist when women jumping 14-15m are compared with men who also jump distances in that range.

JARVER: Observations and available studies from Russia indicate that female triple jumpers' lack of strength is responsible for a more passive rolling action over an elastically bent leg in the landing and the take-off for the step and jump phases. A comparison of the dynamic parameters reveals that women are behind male triple jumpers in their ability to utilize their run-up velocity and have a poorer combination of hop and step.

As far as training methods are concerned, the available information indicates that female triple jumpers in the elite category differ very little from male. Their training loads are closely related but are somewhat less intensive. Perhaps the women should pay more attention to strength development to overcome some of their technique shortcomings.

GAMBETTA: There are not the number of specialists in the event. It is basically still a secondary event for the long jumper. For further information on the women's triple jump I refer to an article by Vitold Kreer 'About The Female Triple Jump' in the January 1993 Vol. 31 issue 1 of *Modern Athlete And Coach* for further specific information.

From your experience (or observation) of the women's triple jump, what differences have you noted, in technique or in training methods, between the women's and the men's event?

PFAFF: I have found that the biomechanical considerations for women triple jumpers are very similar to those for male jumpers. In terms of training qualities there are some obvious differences in our methodologies. The female jumper has a higher elastic strength capacity, thus the volume, density and intensity of elastic training take priority. Our women take longer to recover from absolute strength sessions so the density and recovery techniques must be adjusted in comparison to those of male jumpers. Postural stability/strength for women must be continually addressed. This quality diminishes rapidly when not trained and seems to require a large volume of maintenance. Hip immobility and its resultant effect on ilio-tibial band injuries also are more prevalent among *our* female jumpers. A final concern is the blood chemistry of the female jumper. Radical changes in the levels of calcium, iron etc during periods of demanding training and/or menstruation can lead to a multitude of injuries. Failure to monitor and adjust for these occurrences can derail even the best training programmes.

SANDERSON: The women's Triple Jump is still in the developmental stage. It remains to be seen how it will evolve. One observation of current technique is that women seem to lack the strength required to obtain a 'big split' during the hop and step phases. As a result the front side distance is reduced leading to a shorter hop and step. In addition, the reduced front side distance limits the 'active landing' and the distance that the athletes centre of mass travels over the foot. As the specific strength level of female triple jumpers increases, I believe that their technique will move toward that used by the top male jumpers.