1. There is some confusion between the two "types" of depth jumps. Could you please briefly describe the two variations, the differences between them, and which you believe is the correct training means?

In my opinion, such confusion regards not two "types" of Depth Jumps, but two different jump exercises: Depth Jumps and Drop Jumps. The terms "Depth Jump" and "Drop Jump" are often understood as synonyms and both are used to name the same exercise: the jump in depth with vertical rebound. However, in 1987, Martin Bobbert, writing about Drop Jumps, evidenced two different techniques of its execution, which influence the magnitude of the enhancement of forces and the power output: the Countermovement Drop Jump and the Bounce Drop Jump. The Countermovement Drop Jump corresponds to the Depth Jump, as proposed by Y.Verkhoshansky (1959), the Bounce Drop Jump - to the Drop Jump, proposed by P.Komi and C.Bosco (1978).

If we analyze the execution technique of these two jumps and the physiological mechanisms involved, we will discover that they are two different exercises, which should be used for different purposes.

	Depth Jump	Drop Jump
Purpose:	increasing the Explosive and Maximum Strength in concentric push-up movement	maximizing the mechanical output of knee extensors and plantar flexors by effective storage of elastic energy in the transition from the eccentric to the concentric phase
The goal in their execution:	the highest vertical rebound (using overhead goal)	the highest vertical rebound with the minimal ground contact time
Execution technique:	Is executed without rigid restrictions on the magnitude of legs flexion at the end of amortization phase and on the duration of ground contact time	Is executed with the low magnitude of leg flexion during amortization phase and with the short duration of ground contact phase
Drop height:	0.75 m and 1.1 m	0.3m and 0.6 m
Main physiological mechanism involved:	CNS stimulation by the sharp ground impact	Stretch reflex potentiation and elastic energy recoil

Both exercises emphasize the reactive ability of the athlete in performing the reversal landing-take-off movement. However, the use of different drop heights and different motor

goals determines the differences in the involvement of physiological mechanisms and, as consequence, the different purposes of these jumps.

Which do I believe is the correct training means? I think that both of them are correct, if each one is used for the correct purpose. However, in the use of Drop Jumps, there are some problematic issues. The first issue regards the danger of Drop Jump for the leg joints, especially if performed from a high drop height. In fact, the important condition for efficient recoil of the elastic energy is the muscle's stiffness during the amortization phase. In order to assure this condition, Drop Jump should be performed with low level of leg flexion at the end of ground contact phase. However, if the athlete "drives as a stake" into the ground, with the straight legs, the ground impact is too hard for his leg joints. This opinion has been confirmed by many researchers (for example, by B.U. Newton, W.B. Young, W.J. Kraemer and C. Byrne, 2001). To avoid the danger of sharp heel impact, it has been suggested to use Drop Jumps only with low drop heights of 20–40 cm (Bobbert et al., 1987; Lees & Fahmi, 1994). The problem is that the use of 30cm drop height is ineffective at increasing the rebound height: it could assure only decreasing ground contact duration (W.Taube et al., 2011).

The second problematic issue is related to the coordination difficulty in performing Drop Jumps: the "double" goal of obtaining the highest height and also the minimal ground contact time implies a controversial solution for solving the motor task . Thus, Hunter and Marshall (2002) assumed, that "*if the subjects were not advised by instructions like: ''Keep the duration of ground contact as short as possible,'' or ''Bend your knees very little,'' subjects would automatically adapt their jumping strategy in the direction of a lower leg stiffness, greater depth of countermovement, and longer ground contact times*", i.e., in the direction of Depth Jump execution.

W.Taube et al. (2011) tried to solve this problem, applying the task-constrains approach, based on the assumption, that *"the direction of adaptation is not guided mainly by the instruction but by the task itself"*. They supposed that using Drop Jumps with high or low drop heights, it's possible, without additional instructions, to emphasize the force or the speed component of power output in rebound: *"high drop heights should be implemented into the training regime if the goal is to maximize the rebound height and if the duration of ground contact is not a limiting factor of performance. On the other hand, low drop heights should be preferred to maximize power output in time critical disciplines"*. The problem is that the Drop Jumps with high drop heights are dangerous for the leg joints (Bobbert et al., 1987; Lees & Fahmi, 1994).

How could we solve these problems? I think, that the better solution is not to solve these problems by using Drop Jumps, but to avoid them by using exercises other than Drop Jump, which are more simple to execute and less dangerous for the leg joints. For example, to increase the vertical jump height in the sport disciplines where the duration of ground contact is not a limiting factor for the performance, it's better to not use Drop Jump with high drop

height, but it's better to use Depth Jump. In *"time critical disciplines"*, such as sprint running, to maximize the power output of legs propulsion movements, without increasing the ground contact time, it's better to not use Drop Jump with low drop height, but Hurdle Depth Jump and/or multiple consecutive jumps over hurdles.

To increase the athlete's capacity of elastic energy utilization, it's better to not use Drop Jump -single take-off movement - executed with maximal effort, but multiple bouncing jumps, executed with the goal of maximizing the number of take-offs without increasing the magnitude of voluntary force efforts. For example, the multiple bouncing Box Jumps may be very useful for this purpose. They include the elements of two jump exercises: Drop Jump and the multiple ankle plantar flexion bounces, proposed by C.Bosco to evaluate the elastic ability of athletes.

2. Many coaches look solely at "strength" in preparation for the use of the Depth Jump. Could you please elaborate on other qualities or benchmarks that should be achieved prior to implementing the Depth Jump in an athlete's physical preparation program?

First of all, I have to outline that the problem of athlete's preparation for the use of the Depth Jump should be seen from the point of view of the organization of training process as whole. The fundamental rule of the training process organization implies the gradual increase in the magnitude of training stimuli. In the jump exercise, the magnitude of training stimuli is determined by the level of neuro-muscular system exertion, which is related to the level of force applied in the landing-take-off movements. According to this criterion, all jump exercises may be put in a progressive hierarchical scale: from Jumps without weights (standing jumps and bounds), to Jumps with weights (Barbell and Kettlebell Jumps), to Depth jumps.

In the training process, the jump exercises should be applied according to this progression, with gradual substitution of the less powerful by the higher powerful exercises. This rule was elaborated by Y. Verkhoshansky as the Conjugate-Sequence System, which regards both the sequential applying of different jump exercises in preparation period and also their sequential introduction in the training process for beginners.

So, Depth Jumps should be used only by the athletes who have undergone the jump exercises progression and already have the qualities which allow the body to give an adequate adaptation response on such a powerful training stimuli, as it happens in the Depth Jump. What are these qualities? The suggestions, which could be often found in the sport training literature, indicate that, to be ready to use the Depth Jump, the athlete should strengthen the leg muscles. But, if that is enough, why then do athletes who have a high level of legs strength via the Barbell Squat often have difficulties executing jump exercises? The problem is that the athlete's ability to perform jumping exercises - the jumping ability - depends not only on the

strength of his legs, but also on his coordination ability to efficiently apply his strength during their execution.

In fact, according to W. Ebben, C. Simenz and R. Jensen (2008),*" in some cases, plyometrics previously reported to be of high intensity, such as the depth jump, yielded relatively little motor unit recruitment compared with exercises typically thought to be of low intensity",* such as two-foot ankle hops, tuck, pike, and box jumps. This case regards the training of beginners in jump training, who are still not able to coordinate (concentrate) the force efforts during the landing-take-off movements; to be ready use the benefits of Depth Jump training, these athletes should improve before their jumping skill.

In substance, Jumping Skill is the ability to execute the landing-take-off movements with the correct muscle relaxation-tension pattern in order to:

1. apply the active push-up force effort in the correct moment of time, efficiently using in rebound the force of involuntary muscles contraction, provoked by stretch reflex and elastic energy recoil;
2. perform the push-up movements with the correct muscle activation pattern, using the greatest fraction of sequential energy flow, from the hip to knee and ankle joints, in the vertical displacement of the body mass centre.

The first component of Jumping Skill is important to assure a high performance in the Short coupling time exercises, such as leg-to-leg bounces, Tuck jumps, and jumps over hurdles. The second component is important to assure a high performance in the Long coupling time jump exercises, such as the "frog" bounces and the standing squat jumps. In both cases, the compulsory condition of a high performance is the capacity to relax muscles before and after take-off movements.

So, it's possible improve Jumping Skill using the appropriate exercises, which are able to emphasize each of its components separately. However, the athlete should be able also to integrate these two components into the appropriate motor pattern, in relation to the morphological-functional particularities of his motor apparatus, e.g., to ensure that his hips, knee and ankle joint musculature " *have the ability to appropriately contribute to their joint mechanics, and integrate this into the appropriate movement strategy" (* R. Patel*,* 2010*).* In order to get the initial improvement in Jumping Skill, the first step of jump exercises progression uses a combination of Short coupling time and Long coupling time jump exercises. At the beginning, these exercises should be performed with moderate (sub-maximal) power output, trying to relax the muscles and to maintain fluidity of movements (according to the Extensive methods of jump training). Only when the execution technique of the athlete has been improved in such a way that he will be able to perform every exercise lightly, easily, without losing much energy, it's possible to increase gradually the force applied in ground propulsion movements, until the same exercises will be performed with maximal effort: as quickly as possible or as powerfully as possible (according to the Intensive methods of jump training).

In the second "step" of the jump exercises progression, when the jumps with weights are used, the athlete should try to adapt his jumping skill to the new conditions of exercises execution – execution with a higher magnitude of external force to overcome in the landing-take-off movements. In other words, before moving on to the following step of jump exercises progression, the athlete should improve the jumping ability in performing the exercises, which were used at the preceding step. These exercises should be applied in such a way that a gradual increase in the athlete's explosive strength, expressed in the landing - take-off movements, will be assisted by improvement of execution technique, more exactly, by its gradual adjustment to the level of explosive strength increasing. Only in this way it's possible to prepare the athlete for an effective use of the Depth Jumps.

3. Could you please describe the differences between "Extensive" and "Intensive" methods in regard to jump training? When would each of these methods best be utilized?

The difference between these methods consists in the intensity of exercise execution. Intensity is the quantitative characteristic indicating the level of exertion of a given motor function under the influence of training stimuli. In jump exercises, it regards the level of force applied in the landing-take-off movements. As we already know, when athletes need to increase the intensity of training stimuli in jump training, he should come up at the following step of jump exercises progression, i.e. to start using the other jump exercise, which performance regards the applying of a higher level of force in the landing-take-off movement. However, the same exercise could be executed with different levels of intensity.

How is it possible to realize this task? Very often, coaches think that to obtain the needed training effect, he should only to explain how exactly the athlete must perform the exercise and, after, evaluate the performance and note the errors. The problem is, that humans have difficulty controlling the force-temporal characteristics of such natural, "native" movements as jumping and running. The only way to change these characteristics is to impose such conditions of the exercise execution, in which the body will find a solution by itself. In the motor teaching of beginners, this method is named "heuristic", because it is based on the so named Discovery Learning. In the training of more expert athletes, it is known as the "task-constraints approach".

According to this approach, it's possible to change the motor pattern of "natural" jumping movement, setting up different conditions of the jumps execution and different goals to obtain.*"…Goal, understood as an encoded in the brain model of a desired future, defines processes that should be considered as goal oriented*" (N. Bernstein, 1966). Trying to obtain a definite goal, the human motor system is able to adjust the movements coordination unconsciously.

In the case, when the same exercise is performed with different task goal, we usually talk about its application according to different methods. In applying the jump exercises, there are two such methods: Extensive of Intensive.

	Extensive methods	Intensive methods
Main characteristics of the jump exercises execution	Moderate (sub-maximal) power and an optimal amount of work	Maximum effort and a small amount of work
The athlete's instruction how to execute exercise	*"Try to execute the exercise with moderate effort, maintaining fluidity of movements"*	*"Try to execute the exercise with maximal effort: as quickly as possible (or as powerfully as possible)".*
The training purpose:	Improving the technique of exercise execution while gradually increasing the level of explosive strength	Increasing the level of explosive strength expression in the take-off movement or decreasing the length of the ground contact time.
- in the using of the Short coupling time jump exercises	- to find the correct muscle relaxation-tension pattern during the Stretch-Shortening Cycle execution, which assures the Spring ability expression (the elastic energy recoil);	- to decrease the time of force employment
- in the using of the Long coupling time jump exercises	- to adjust the muscles relaxation-tension pattern (the correct moment of the active force employment during the Stretch-Shortening Cycle) with increasing the amplitude and the coordination difficulty of movements	- to increase the power output in take off movements
General characteristic of training load	Low intensity and the optimal amount of work.	High intensity and a small amount of work.

For example, when only the jump exercises without weights are used, the athlete should carry out Bounds and Double leg consecutive jumps with forward displacement: Hurdle jumps over 10 hurdles and “Slalom jumps” over gymnastics benches or two parallel rubber cords, executed with advancing the side-to-side jump over the length of 8-10 m. These exercises may be performed in two different ways: using the Extensive method to improve Jumping Skill and using the Intensive method to increase the power output.

	Extensive methods	Intensive methods
Bounds	“Long” bounds: 1. Leg to leg bounds; 2. Bounds with 2 right- 2 two left leg take offs; 3. Bounds 2 right- 2 two left leg take offs;	"Short” bounds: 1. Single double legs long jump. 2. Alternate legs triple jump 3. Alternate legs five-fold jump; 4. Alternate legs ten-fold jump;

	4. Bounds on the right leg; 5. Bounds on the left leg; 6. Two legs take off bounds ("Frog"). At the beginning, only 1 series should be carried out. The length of distance, in every exercise, depends on the athletes capacity to perform the exercise with the high amplitude and the looseness of movements. When the athlete will be able to perform easily the leg-to-leg bounds on the 80-100 m distance, one-leg bounds - on the 60-80 m distance and "Frog" bounds - on the 30-50 m distance, the number of series should be gradually increased until 3-4.	5. Double legs "Frog" triple " jump 6. "Frog" five-fold jump 7. "Frog" ten-fold jump The length of every jump exercise should be measured. The number of repetitions is usually 3-5 and depends on the results obtained by the athlete: when he will be not able to increase the result, he will finish the exercise repetition and pass to the following exercise.
Consecutive jumps with forward displacement:	The exercises are executed, trying to maintain the arms and shoulders relaxed. With improvement of athlete's ability to execute these exercises without losing much energy. The number of every exercise repetitions and the number of series should be gradually increased from 3 (at the beginning) to 5-6,	The exercises are executed, trying to decrease the time of exercise execution. The number of every exercise repetitions depends on the result obtained by the athlete. The rest interval duration, after each repetition, should be long enough for the complete recovery.

Also, at the following step of jump exercises progression, when the athlete uses the jumps with weights, these exercises could be executed differently:

Method	Extensive	Intensive
Purpose	Adjusting the jumping skill to the higher magnitude of external force impact.	Increasing the power output of take-off movement (the vertical jump height).
Exercise	Consecutive Barbell Jumps, executed with the weight of 15-25 kg, bending the knees at least until the thighs are parallel to the floor. The exercise consists of 10-20 consecutive jumps, executed with constant height, degree of leg flexion and vertical back position, without pausing between them and maintaining an optimal height and frequency of jumps.	Vertical Jumps with Barbell, executed with the weight of 30-60% of maximum, as a 'sets' of single jumps with the brief relaxation between them. The exercise consists of 4-6 jumps performed with the aim to jump as highly as possible.

When would each of these methods best be utilized? Beginners should start the jump training using Extensive methods, because, before performing new jump exercises with maximal power output, the athlete should improve the technique of its execution. When the execution technique of the athlete improves, Intensive method should gradually substitute Extensive methods. For example, if the jump training is used 3 times a week (Monday, Wednesday and Friday), the Intensive methods are applied only in Monday, after some weeks - also Wednesday.

The same approach may be used also when the athlete begins to carry out the Barbell Jumps. The athlete should begin with the Consecutive Barbell jumps. When he will able to perform this exercise lightly, easily, without losing much energy, it may be substituted by the Kettlebell Squat Jumps. Kettlebell Squat Jumps have a deeper influence on the leg muscles, in comparison to the Barbell Squat Jumps, because they are executed from the lowest position at the end of the yielding phase. Both exercises are executed with the constant sub-maximal power output of multiple take-offs, with control of the execution technique and with definite number of repetitions. In other words, they are performed according to the Extensive method. When the athlete will improve the technique of these exercises execution, he may pass to the Intensive method of Barbell Jump training, using the Vertical jumps with Barbell. This exercise is executed with the aim to jump as highly as possible, i.e., according to Intensive method.
The last step of jump exercise progression, Depth Jumps are carried out only according to Intensive method, because, in every jump, the athlete should jump as high as possible, trying to reach the overhead goal.The same approach is used also in applying the jump exercises in the preparation period. For example, in the training of high level athletes, who use the Block Training System, Extensive methods are usually applied in the Block A, Intensive methods - at the end of Block B or in Block C

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4. When looking to develop speed -strength qualities in an athlete, how does a coach know that the athlete is ready to progress with either intensity of the load, or intensity of the means selected?

In one of his early articles, Y. Verkhoshansky analyzed the regularities of the athletes' performance improvement during multi-year training process, from the point of view of the relationships between two main components of this process: increasing the athlete's motor potential and the improvement of his ability to apply his motor potential in the motor structure of competition exercise. These regularities, which regard the phases of increasing the power output in competition exercise, could be considered as valid also for the phases of increasing the athlete's performance in the single training exercise. Every new exercise, introduced in the training process and systematically used for the long time, increases the athletes performance in this exercise. However, in the different phases of this increasing, it is assured by different factors:

1. at the beginning - mainly, by to the improvement of the athlete's execution technique, in other words, by the improvement of athlete's ability to execute movements with the correct muscles activation pattern;
2. in the second phase, when the athlete became able to apply the force efforts in a correct way, during the exercise execution, the main factor of further increasing the exercise performance is the increasing magnitude of force, applied in these force efforts;
3. in the third phase, when the morpho-functional changes in the athlete's body bring him at the higher level of work capacity, the increase in exercise performance slows down,

because the exercise has not provided the body with the adequate training stimuli, able to assure the further increasing of the athlete's performance; it should be substituted by the new exercise.

So, the athlete is ready to progress to the higher step of jump exercises progression, when the actually used exercise ceases to assure the improvement of his jumping ability. To evaluate the athlete's jumping ability improvement, the observable characteristics of exercise execution could be used: the level of power output in landing -take-off movements and the level of movements lightness. When the Intensive methods are used, the coach should measure the jumps length or height in every repetition. When the Extensive methods are used, he should control the quality of exercises execution and how long time the athlete is able to keep this quality during their execution: at what distance in the single bounding exercise and at what number of repetitions the athlete begins to lose the jump's height or length and the lightness of movements.

So, the coach should give more attention to the visual observation of the athlete's movements. This is the case, which regards the employment of his professional abilities, based on his experience. For the coaches, who have little experience in jump training, I may give the following suggestions. First of all, I suggest that coaches, before using the jump exercises, create in his mind some kind of qualitative "scale" of jump exercise performance, observing their execution by the athletes with different experiences in jump training: from the beginners to the high level track-and-field jumpers. This scale will help the coach to understand what qualities his athlete lacks and from what exercises he should begin to improve his jumping ability. However, it does not means that his athlete, beginners in jump training, should try to immediately obtain the same characteristics of movements as the high level jumpers. The process of improving his jumping ability could be long.

For this reason, my second suggestion for coaches is to formulate the realizable training tasks for the actual preparation period of a given athlete. The beginner is not able to reach, during this period, the same level of jumping performance, as the high level jumper, but he should try to obtain the *improvement* in determined characteristics of jumping ability during the determined period of time. The level of such improvement will depend on the duration of this period and the coach's professional abilities, as also on the level of athlete's motivation. For this reason, my third suggestion for coaches is to involve the athlete in the training process, as his collaborator, able to understand well the actual training tasks and the goals to obtain. This will help him to perceive better the changes in the characteristics of his performance, during the training process and to inform the coach about his actual state.