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EDITORIAL

CONCERNING THE ADVANCED SCIENCE IN HIGH PERFORMANCE SPORT[1]

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ABSTRACT

The advanced sciences are based on the most recent huge increasing of technology and on interdisciplinary commencement of great interest topics, as top sport is considering. The main problem in top sport seems to be the obtaining high sport's performance in as short as possible time, having great efficiency and minimum risks.

The cell-engineering domain, in which the author of this paper has a modest contribution, is a means of genetic control for human performance, including sport, gene expression, molecular interactions within the cell, intracellular signalling, cell mechanics and motility etc.

The domain of *Psyche*, of controlling feelings and manifestations, is also, on the focus of top sport interest, especially for the reason that, from inside of this domain, is feasible to accede at the biological reserves unavoidable in normal conditions, but avoidable in emergency or surviving situations.

The new knowledge about energetic metabolism, about the rotation of ATP molecules, or coming out from scientifically experiments of association of nutrients or of reconsidering the recovery stimulants after effort, are providing, also, very useful information for top sport practitioners.

It is not to disregard the contribution of the new information about the human physical limits, biomechanics, tactics of doing and controls the physical effort by means of sensorial biofeedback or the performance's advantages coming from new high-minded techniques and materials of sport accessories

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REZUMAT

DESPRE ŞTIINŢA AVANSATĂ ÎN SPORTUL DE PERFORMANŢĂ

Încercăm să semnalăm implicaţiile descoperirilor ştiinţifice de avangardă şi a tehnologiilor moderne în forţarea limitelor performanţelor sportive. Nu comentăm aspectele etice sau pe cele ale unor norme de protecţie a sănătăţii în aplicaţiile grăbite, dar suntem tentaţi să remarcăm că tendinţa de a obţine performanţe sportive cu eficienţă crescută şi în timp cât mai scurt aduce inevitabil în discuţie gradul de risc biologic şi urmările sale pe termen lung. Se pare că sportul de performanţă actual are tendinţa de extindere a spiritului său competiţional şi a formei sale spectaculare la business şi la ceea ce se poate înţelege prin „fenomen social manipulabil". De aceea, o serie de procedee experimentale se aplică deja fără cântărirea efectelor negative, cu intenţia vădită de „performanţă cu orice preţ". Pe de altă parte, implementările noilor cunoştinţe despre procesele intime, celulare şi moleculare, ale conversiei energetice musculare, ale controlului emoţional şi ale reglajului starilor psihice, asociate cu strategii flexibile şi managementul profesional al pregătirii sportive individualizate au, neîndoielnic, efecte benefice, reprezând forma specifică a progresului observabil în toate domeniile vieţii.

INTRODUCTION

The advanced sciences are based on the most recent huge increasing of technology and on interdisciplinary commencement of great interest topics, as top sport is considering. The main problem in top sport seems to be the obtaining high sport's performance in as short as possible time, having great efficiency and minimum risks.

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STEM CELL ENGINEERING

In the beginning, the stem cells, so called *"mother of all cells"* are pluripotent, and are able to reproduce indefinitely. These cells are able to split into more than 200 cell types, such as heart, liver and muscle and so on until the nerve cells. It is hard to believe that, in the next few years, it will be possible to replace the devastated tissues of many terrible diseases, like Parkinson, diabetes or chronic heart dysfunction, as a result of stem cell-engineering. This development gives great hope and optimism to those involved in this science. For me, having seen under the microscope how the nervous cells multiplies and develops, it is not doubt that these predictions can become reality earlier. Some years ago, culture from these cells has been grown in nutritive three-dimensional medium by nanotechnologists, protein chemists and polymers experts, now the specifics stem cells are stimulated to multiply and grow *in vivo*, using ions pumps. Long time it was supposed that in the case of a very infrequent disease of uncontrolled hypertrophy of muscles should be a genetic ground. The patients of this terrible syndrome where obliged to made frequent complicated surgical rejections for to reduce own muscular mass. In our day the defected gene was identified. Let us imagine how grotesque will looking the spectacle of sport if the idea of voluntary modifying under genetic engineering of this gene would be putting in practice in high performance sport?

The surprising beneficial effects on human health start to come not only from dethroning the DNA myth or old scientific beliefs such as, for instance, the impossible multiplication of nervous cells, but also from the innovative designs of monoclonal antibodies, so called "magic bullets". This new source of potent therapeutic drugs, no longer allergenic, due to its human origin, will revolutionize the diagnosis, the prognosis and the treatment of many diseases considered incurable as AIDS was. Finally, for most natural molecules, these "magic bullets" will force our immune system to produce antibodies.

Following the experimental models on animals, it may be possible to identify some gene responsible for sport aptitudes and attitudes in top athletes.

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We should not be surprised if, due to cell-engineering, it will be possible to control the multiplying of human blood cells, eliminating the use of the (prohibited) pseudo-transfusion techniques using one's own oxygenated blood.

At the moment, it is only the cost of surgery that makes it difficult to substitute a broken meniscus with a new one grown in vitro from a cell extracted previously from the injured sportsman. The cell, reproduced and developed into a nutritive medium and three-dimensionally designed on protein support, becomes mechanical process material, and finally, a "spare part" that will not be rejected by the body. All specialists in top sports know that speed (or velocity) is a native motric skill and are sceptical of the vast improvements in an athlete's speed during the training process. In other words, the stability of an innervating regime makes the skeletal muscles predominantly slow or fast (red or white). Will cell-engineering change our classical convictions about muscle contraction speed? The above-mentioned applications, more or less actual, do not represent an inventory, and are not a list of selected applications. They serve only to provoke and generate questions or controversies.

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PREDICTABLE MODELS

Some shifting are to be observed regarding the scientifically methods of research; the competition between theory and practice becomes a strong and efficient collaboration, due the high powerful computers. Today, the frontiers of unknown are enquiring no more by opportunity, but conversely on the basics of modelling, looking direct to the scientific target.

A kind of modelling is using predictive logic-mathematical patterns. For instance, the predictive logic-mathematical pattern of the control of multiplication, growing or development of the cells, on which the author of these lines consider himself a specialist, are the aptitude to decide the practical solutions, the kind of exciting. Regarding this idea, we also addressing, the conviction, due to different reasons, religion included, do not accepted that the nature and the life can be copy at all, saying that we are on the same estimation. The reason is not so much the models, which can't replace the originals, indifferent of its performances, but the reason can be the fact that the eutrophy is not in our human systemic mode of thinking.

May we add that, if we attribute in our logic-mathematical models a rudimental intelligence to the cell, holographic to human intelligence, always is coming out the necessity of taking into account of a paratyping factor, different as genotyping or phenotyping ones. It is the same as, in spite of chromosomal information, of medium stimuli that produces adaptation or mutation reactions, might be necessary a strange supply, non-definite as energetically or informational entropy.

DRUGS SUPPORT

As particularly in this paper, the approach of doping topic[2] is different from the general one due to the fact that we are not referring to its combating, but to its prevention, putting into attention that cell engineering and hormonal sustain can be used, besides noble meaning, for the artificial amplification of sport performance (by increasing of physiological aptitudes and psychical attitudes).

From the wholesome and humanitarian desiderates of using of cell engineering to the production of oxihemoglobin conveyer blood cells for athletes, to the mutation of cells which can accelerate the re-synthesis of ATP or to the modification of the phasic-tonics contraction regime of muscle, is only a step, but a step over one deep crevasse… one ethical crevasse which diverge virtuous using of hormonal support for medical purpose from immorally using of it for instrumental doping.

Some stimulants (e.g. caffeine, methylphenidate and the amphetamines) are considering doping substances, but ampakines do not seem to have unpleasant, long-lasting side effects. They are currently being investigated as potential treatment for a range of conditions involving mental disability such as Alzheimer's disease, Parkinson's disease or neurological disorders as Attention Deficit Hyperactivity Disorder (ADHD), among others. Lately, study they were shown to have an effect after they had left the body, continuing to enhance learning and memory. More recently developed ampakine compounds are much more potent and selective for the AMPA receptors used in sport activity, fact that becomes in the attention of sport specialists.

[2] Knowing that doping is both unhealthy and dangerous for the athlete as much as it is immoral and unethical; usually the discussions about doping are focuses over the records by anti-doping control and over the sanctions by applying the anti-doping code.

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Well, we are trying to use the about mentioned idea to alert and prevent *on time* the family of sport friends about the possibilities of unfair destination of advanced research results like these from cell engineering, not *post factum* as it happened before with many doping substances, first find out in athletes, and after reached on the prohibits list.

It is well know that nutrition has significantly contributed to the success and outgoing improvement of performance in health and sport. Surprising is the fact that scientists are still focus their attention on new formulae of energizing nutriments. Theoretically saying, science of nutrition has not yet riches his limits; some examples are good arguments but not enough for demonstration, maybe commercial interest is involves

The feeling of tiredness, exhaustion, ache, physical and psychical uncomforting can be signs or signals of excessive mechanical energy consummation upon a weighty physical sport effort. These states are beneficial for the body, sustaining the homeostasis effect of defence. Their complex mechanisms of action include chemical and hormonal mediators.

No far ago, some neurotransmitters, like analgesic endorphins discharged by explicit organs or tissues, where discovered. The analgesic endorphins break the homeostasis effect and can produce a euphoric sensation and ecstasy of success. Recently, scienctists have hypothesized that the release of endorphins is the neurochemical cause for the feeling of pleasure. For example, a marathon runner's "high," which has been compared to the "rush" following opioid use, is the product of endorphin release[3]. After a physical injury, endorphins activate opiate receptors and produce an analgesic effect, alleviating severe pain. During times of emotional stress, endorphins are released in the limbic system of the brain and produce a euphoria that lessens anxiety and melancholy[4]

It can be questionable the practice of the artificial stimulation of the effect of analgesic endorphins for pushing the limits of sport's performance, but, certainly, the exogenous takings of these neurotransmitters is a doping demarche, not yet being of the "black list" and probable not easy for detecting.

In our assays for to vectorize the potential of disposable energy in physical sport effort, we have placed up a hypothetical orthogonal constituent of this potential, called "nervous energy". We have sufficient reasons to consider that analgesic endorphins diminish the symptomatic effect of the nervous component of the potential of energy.

As well as in medicine where the joining of two drugs can produce a different effect as a summation of the each solitary effect, on nutrition, the mix of two or more nutrients can be sometimes favourably or detrimentally for the efficiency of training practice. As for instance, in the trivial combination of cheese and tomatoes, besides delicious, some acids from tomatoes makes insoluble gastric the calcium from cheese, diminish the returns of ionic calcium for compensation of the calcium used in effort process.

For a good function of the muscular effectors, it is necessary some correlation and equilibrium between minerals, as for instance, between those containing calcium and those containing magnesium.

One of the top technology of testing, dosing and control of the de disequilibrium of the corporal minerals is TMA (Tissue Mineral Analysis), on which by analysis of a hairbreadth, a some weeks mineral history can be recognized. Many top athletes are using TMA for dynamic correction of the diet and mineral supplements. In some scientifically acknowledgment of nutrition for athletes is mentioned not only the mix way, but also the correctly successive management of the nutrients.

PSYCHOLOGICAL INSTRUMENTS

The high sport's performance is closely depending of efficiency of emotions control and of resistance at stress factors. There are many psychological methods of sport training on which the level of emotions are wherever controlled and the mechanism of reducing the stress effect is ameliorated. The most recent way of controlling the nervous instances involved in producing emotions and stress effects refers to sensorial feed-back; on which the inadequate reactions are vanished.

We successfully tried an acoustic feed-back of the cortical activity level, sounding the cerebral rhythms during the psychological training. After some applications, the athlete learns itself how to control the cortical activity level, and circuitously, how to reduce the supplementary emotions and exaggerated reactions at stress factors. The process can be committed to memory and used in competition, without any reactive feed-back.

Between well-known natural human being instincts, recently, was accepted also the competitive instinct. At some infrahuman species, this instinct is very evident, as for instance at very young vultures or farrows, which are fighting till to the end for food. From human being point of view, this fight is apparently very cruel, but the nature have created this instinct as a necessity for survive competition. The competitive instinct can easily confounded with well-known belligerent comportment of human male, but it is to mention that the

[3] Hawkes, 1992
[4] Rang et al., 1995

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competitive instinct is something else as an effect of male hormones. Humans periodically attempt to raise the standard of their competition closer to the way nature intended, by playing sport. Then they can compete for fun, and according to rules and rituals, in a similar vein to those that are so widespread throughout nature. Of course, they often take their sport too seriously, especially when money is involved or when they allow their pitiful sense of struggle to get the better of them.

We joint to whoever scientist accept that the competitive instinct is a characteristic of a sequence from the common genome of evaluated beings. The genetic structure responsible for competitive instinct came under focus because of medical interest, but it's easily to suppose that sport interest can come soon. It is to observe that people who are bodily undersized strive to be more aggressive and to have improved spirit of competition as gigantic persons. Maybe, it is a kind of instinctive compensation using dynamics and speedy reaction against force or impressive sizes. The Galton theory of regression, meanings that the human being soma trend to middling, seems to have a scientific explanation on competitive instinct. Otherwise, the human race could come polarized; meaning that from massive pears would results massive descendents, having dominative tendency and vice-versa.

Tele-suggestion and hypnosis are considered doping instruments and are forbidden. It is not yet clear how much self-suggestion influents the high sport's performance and if self-suggestion can be harmful that need to be not allowed.

In some practice based on belief as religious conviction, the self-suggestion can have the same effect as tele-suggestion, inducing spectacular morpho-functional modifications and, much more; can contribute to cure oneself some maladies. By other hand, we have measured 5-7 times bigger isometric forces in athlete, in the case of cataleptic state (a kind of body rigidity) by voluntary hypnosis, than in normal conscious state. It is known that the liver can ensure survival with only l0% of its functional potential, that the heart of top athletes can execute 5-7 times its normal work, that normally, we use only 8-12% of our brain capacity and so on. It is to suppose that self-suggestion can also open access to the corporal reserve of energy. The true problem seems to regard to the cost and the consequence of the access to the corporal reserve of energy; taking into account the fact that nature does not give us anything without us having to pay.

In sport, the method of autogenic training use some means of self-suggestion as mental training and relaxation exercises. The mental picture of the biomechanics of sport techniques is at this moment a current practice for the autogenic training (or so calls theoretical sport grounding).

Today self-suggestion use advanced techniques of sensorial control, on which the movement is not only mental representation, but also executed and perceived at the effector's level as mechanical tensions in successive sequences. The consciously movement seems to become a means of psycho-somatic training. There are sufficient reasons for us to consider that psycho-somatic training can help a lot in the case of sport event where the executing techniques are important.

BIOMECHANICS AND MATERIALS

We have extended the biomechanical analyze to analytical biomechanics, meaning that some similarity, as for instance, the relationship between the debit of the fluids and their hydrostatic pressure, can be call up in mechanical work of an athlete.

In most sports, performance is based upon maximal speed and the time the former or a similar speed can be maintained. From a causal point of view, maximal speed is determined by the difference between the active force and the resultant of the resistive forces (i.e. net force), using as a means the personalized measure called (like in electricity) *admittance*. In our opinion, admittance (the manner in which speed depends upon force), is conditional upon several factors, as are the forces resisting movement, gravitational acceleration, duration of the action, promptness of neuro-muscular commands, the condition of the contractile effectors, the manner in which the energetic substrate is resynthesized, etc. Admittance has, as regards biomechanics, the dimension $[T \cdot M^{-1}]$ and appears as a variable coefficient or an individual constant (in case of maximal speed).

The modern technology extended from military research, as high speed video recorders of movements, today don't needs markers for to recognize a point trajectory, fact that simplify the analyze of sport technique by quickly offering the velocity, accelerations and force graphics. Any body segment or sport object can be recognized on each frame by a group of pixels having small differences of color, contrast or brightness, compared by surrounds.

Without detailing the calculation and without invoking the premises of the logical-mathematical model which connects the execution speed with the active force, we may say that *maximal speed* depends especially on the value of *active force*, the weight of the body segment or the object set into motion, the *load or the opposing forces, the distance* of the mechanical work*, and the an individual factor included into the admittance.* In this case the aspiration of analytical biomechanics is to find a way for to increase the admittance.

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In some kind of sports are useful elastic adaptable bandages, tourniquets or malleable equipment twisted on corporal parts. A new material enclosed in these accessories; the intelligent polymers has the enquiring propriety to self-adjust on mechanical tension or temperature gradient, being named *intelligent*[5] just because of the fact that its stretchy is variable and controllable. The intelligent polymers enlarge their aria of application from medicine to top sport.

The corporal equipment or clothes having the propriety of conducting humidity only in one way are already classics, but the materials of equipment that force the water to flood linear on its surface, without any turbulence, imitating the dolphin skin, seems to be inspirited from *science-fiction*, in the spite of the fact that, by now, some athlete or sport devices are used it. Only the expensive prices of this material make taboo, not yet enough sport or ethics rules.

We have to observe, that lately the designation of training periodization and selection of appropriate number of repetition and sets are based on short feed-back of biological reaction in sportsman. It's meaning that efficiency of sport preparation needs to enlarge the classical training team-work.

[5] Stimuli-responsive, "intelligent" polymers are polymers that respond with large property changes to small physical or chemical stimuli. They are also known as "smart", "stimuli-responsive", or "environmentally sensitive" polymers. These polymers can take many forms; they may be dissolved in aqueous solution, adsorbed or grafted on aqueous-solid interfaces, or cross-linked in the form of hydrogels....