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Innovations in Research and Development of Scientific Procedures to Reach the Success and the Excellence by Means of Psychology Applied to the High Performance

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Additional information is available at the end of the chapter

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Abstract

In this chapter, the author discusses a new and specialized psychological intervention with scientific procedures in environments of high performance, showing his experience and achievements obtained in the sport and in the high-level art area. The author has intervened as scientist of support in seven Olympian cycles, being the person in charge of the mental training of numerous champions of the World Sport and Olympian of different disciplines and nationalities. These methods, developed during three decades, have been applied to the sports and not Olympian disciplines with optimal results. In 1988, these methods were adapted to the professional world of the art by the collaboration that the author established with the mythical Prima Ballerina Assoluta and choreographer, director of Cuba's National Ballet Company, Ms. Alicia Alonso. They began to work at the mental training of some of the most prestigious international artists at the area of dance and extending the investigations and interventions to other artistic areas, such as theatre, cinema and, especially, music, where the author has been working directly with some of the first world figures of this specialty.

Keywords: peak performance, hypnosis, biofeedback, virtual reality, trait anxiety

1. Introduction

The psychological intervention with scientific procedures in environments of high performance has allowed us to question many principles of the differential aspects in our species. Are we all qualified to come up to the maximum level? What factors contributed to reach the success and the excellence? Are we all born with equal potential?

These aspects have worried me in many years, answers have derived from my processes of intervention and of the scientific procedures of control and potentiation of the performance that I have realized. The experience and the information accumulated during seven Olympian cycles in which I have developed my work have allowed me to detect some key factors to predict and detect the profiles of success. All the world champions and Olympic medal winners with whom I have worked, checking my database, they have some similar factors that have allowed me to select candidates with big possibilities of success and to move this information to other distant environments of the high sport performance as is in the artistic area. One of the most important variables, drawing the most attention, is a variable present in all those have reached the excellence and stay away in everyone physically and technically could have reached it, but they never achieved it. This variable is a psychological factor that is not genetic, it develops in first stages of our life with our parents and adult, which is the anxiety and how can we handle it.

The late Dr. Charles Donald Spielberger was a prestigious and outstanding clinical psychologist world-renowned for his work on personality and health. He was the author of one of the tests most valued and used of measure of the anxiety best known as Spielberger's State-Trait Anxiety Inventory (STAI). Dr. Spielberger [1–3] considered that to define the anxiety of suitable form it is necessary to bear the differentiation in mind between the anxiety as emotional condition and the anxiety as feature of personality and for it, he proposed the theory of anxiety state trait. The state anxiety, according to Spielberger, is a “emotional condition” of the human body, characterized by the subjective and consciously perceived strain and apprehension feelings and by hyperactivity of the autonomic nervous system. On the other hand, the trait anxiety refers to the individual relatively stable differences of anxiety, being these a disposition, trend, or feature. Contrary to the state anxiety, the trait anxiety does not demonstrate directly in the conduct, and it must be inferred for the frequency with which an individual experience increases his condition of anxiety. In this respect, people with high degree of trait anxiety perceive a major range of situations such as threatening, and they are more predisposed to suffer anxiety state more frequently or with major intensity. The high levels of state anxiety are perceived like intensely troublesome; therefore, if a person cannot avoid the stress, it will start the skills of confrontation necessary to face the threatening situation. In the investigations realized in the sport environment of high performance, we have found a relation between a low punctuation in trait anxiety (TA) and capacity of success. Numerous champions of different disciplines have a punctuation low TA, not finding any result of excellence with punctuation high TA, this allows us to indicate that this factor is a predictor of success [4–6].

As we have a high performer with physical and technical potential, it is necessary to train to guarantee his results and to reach the excellence. To achieve this, we have to promote his mental capacity using various ways of science of psychology, in the last decades extended with the development of the new technologies of direct application as, for example, the hypnosis, of which later we will develop its characteristics and possibilities. Other technological innovations developed in the sport environment and pioneer applied them have allowed being a source of realization of their potential: the biofeedback and the neurofeedback, the subliminal stimulation and the virtual reality (VR). Using these technologies, we have helped a numerous gymnasts to be champions of Europa of the World and Olympian Medalists,

also, athletes, motorists, and tennis players, and to the champion of the world of chess. This knowledge transferred to the world of the art, we have helped up to reach the maximum professional levels of the art to some of the best dancers and musicians of the world [7–11].

2. Hypnosis/self-hypnosis

The hypnosis is a mental complex phenomenon defined as a condition of high punctual concentration and receptivity to the suggestions that are attracting the attention of the person in a monotonous routine.

The nature contributes two specific moments, between others, that take place spontaneously during the day: the moment of the transitional state from wakefulness to sleep called the hypnagogic state of consciousness; this is one of the perfect moments to program our mind, to suggest modifications in our life, in any process, or to increase our performance. Another moment is to the awakening, the step of the dream to the awakening known as hypnopompic state; it is a lapse of time, in which we can speak directly with our brain to transform conducts and to promote our mind. It is important to avoid, the habit of falling asleep watching the television or listening to the radio because on having done this, we introduce the information that comes to us in our information system and exercises very direct effects on our conduct and thoughts.

During the hypnosis, there takes place a series of phenomena of that they can take advantage directly to optimize the processes of intervention to sports and motor level. For pedagogic reasons, we will consider the following areas to approach the numerous phenomena that the hypnosis carries and that allow to intervene with efficiency in high performance:

- Phenomena associated with alterations in the voluntary muscles.
- Phenomena associated with alterations in the involuntary muscles, organs, and glands.
- Phenomena associated with alterations in the organs of the senses.
- Psychological phenomena associated with the cognitive, emotional activities, and the ideational processes.
- Phenomena associated with the own induction.
- Posthypnotic phenomena.
- Spontaneous phenomena.

2.1. Phenomena associated with the alterations in the voluntary muscles

In hypnosis, the movements of the voluntary muscles can be keep out or excited, it is possible to automate sensations of relaxation, produce paralysis of muscular groups, catalepsy, automatic movements, and increase the muscular performance.

2.1.1. *Automation of relaxation*

With the process of induction, the members of the body sharply tend to avoid the movement and once reached the hypnotic condition and, as one penetrates into hypnotic condition, the muscular tone diminishes progressively, and of this form, the suggestions of rest and recovery of corporal zones are extremely easy. Thus, it is possible to facilitate the recovery of a sportsman in a small interval of time, making possible muscular rests with effective and great ease measurable psychophysiologicaly, not as it occurs using basic technologies of relaxation that not be enough guarantee a certain level. It is extremely useful in cases of overloads of physical training, in moments of sport concentration for the preparation of competitive important events, as a facilitator of the recovery of disabled sportsmen, etc.

2.1.2. *Paralysis of muscular groups*

In actual fact, there does not take place a loss of the motive power, but rather a temporary suspension of the tonicity. The hypnotic paralysis can include small muscular groups such as the eyelids or big groups. There are two types paralysis in nature: flaccid and spastic, depending on the conception that how a paralyzed person behaves. This phenomenon is very useful to learn muscular control for sportsmen with technical purposes.

2.1.3. *The catalepsy*

It is funny hypnotic phenomenon, some of them are found in the circus spectacles, characterized by an involuntary tonicity of the musculature. The members of the body are kept in any position that one has placed them. There exists a muscular inflexibility, a lack of flexibility. Indirectly, it is the indicative for what the individual is in an average degree of depth. Lamentably, many investigations does not exist in this aspect, since it is not easy to reproduce it in any individual, especially to maximum levels that relate to the effects that the Asian teachers of Chi Kung produce and that seem to us to be so inexplicable. Phenomena of the type that a jeep over the body of an individual and does not produce any hurt to him, or somebody break a block of stone on his body. These skills have not trick and many Chinese teachers reproduce relate to the phenomena of the catalepsy in maximum degree, as the of the circus number of putting a person in cataleptic condition sat between two chairs and eight persons sit down above him and the individual neither doubles, nor notices any discomfort once awake.

Catalepsy is an interesting phenomenon that has limitation, in maximum degrees, not everybody produces it easily, but in sportsmen, who reach it in average degree and this if is easy. It might say that for empirical experience 80% of them obtains it and allows correcting technical elements, to erase bad learning and to optimize complex technologies that could be executed in this condition. It is not the same to reproduce and to work with the hilt of a racket, that with a triple pirouette. It is also an excellent practice to reproduce simultaneously visualizations, technologies of mental test on that hereinafter we will comment.

2.1.4. Automatic movements

The automatic movements are movements produced in any muscular group without conscious control. Examples of automatic movements linked with the hypnosis are the hand levitation, which we will penetrate into the technologies of induction. The training in automatic movements is a route adapted to facilitate later phenomena as the writing and the automatic drawing. These phenomena of great usefulness in clinical work are also very useful with sportsmen to level of cognitive recovery of information and of unblocking.

2.1.5. Increase of the muscular performance

In hypnosis, the person can avoid the fatigue and the discomfort posed by certain tasks, and therefore, it can increase his performance, using reservations of power of that in conscious state, the individual does not take advantage. Nevertheless, the individual cannot exceed his physical real capacity; simply he takes more advantage thanks to the hypnosis. The hypnosis brings him over to his maximum limit that normally to ordinary level does not reach. It should be clarified that in this case, we referred to increase of the muscular performance to the hypnotic level. It is only possible possible in some very limited situations, since, in serial movements as that all the performance sports use, the person cannot be in hypnotic condition, because as we have recounted previously, exists a loss of muscular tone. Therefore, the times of reaction are high and with it, we would not do any favor to the sportsman, everything opposite, we would be harming him. This is one of the many reasons by which the hypnosis cannot be considered doping, since theoretically any sportsman can go out to compete in hypnotic condition. Can you imagine a gymnast trying to make his exercises while is half-asleep? What would happen? Would have our dear and big cyclists, Indurain o Contador, won the Tour running half-asleep? It is evident that in hypnotic condition it might not give good results. The increase of the performance we realize it using the hypnosis as a tool in the process interventional of preparation, and during the competition, we can rest on posthypnotic conditions, but not on the hypnotic condition as such.

2.2. Phenomena associated with alterations in the involuntary muscles, organs, and glands

Many of the corporal functions that escape to the voluntary control are regulated by the unconscious mind across the thalamus by the nervous autonomous system. The respiratory, circulatory, and gastrointestinal systems and the endocrine glands are regulated hereby. The unconscious mind has the power to disable or excite the nervous autonomous system, and for it across the hypnosis, all these systems are easily controllable.

2.2.1. The heart

The cardiac rate can be accelerated or can be retarded in hypnotic condition. The experimentation supports this aspect widely and has tremendous implications for the high-level sport, for example, in expert shooters. We know, for the experimental studies, that there is a cardiac ideal rate that allows throwing at the reveille with major precision, by means of this effect of the hypnosis, as it is carried out by the instrumentation of the biofeedback. It is possible

to train to the shooter in order that his cardiac rate fits in competition to the ideal one, and hereby, he has major precision in competition. It is possible to do the same thing with tennis players and other sportsmen, as the football players before throwing a penalty in that the experimental evidence shows an optimization of the performance based on his cardiac rate.

2.2.2. The blood vessels

The hypnotic suggestions can influence on the blood vessels. Many experimental contributions show that the peripheral temperature of the body is possible to increase it in hypnotic condition. The blood pressure and the cardiac rate can also be influenced.

2.2.3. Respiratory system

Numerous experiments and clinical observations indicate that breathing can be influenced and simultaneously influence the hypnotic condition. A very significant experiment realized that an individual in hypnotic condition with rest can increase his pulmonary ventilation up to 50% with simple suggestions of accomplishment of a donkey work [12]. The diaphragmatic breathing associates generally with light conditions of hypnosis, and the abdominal deep and slow breathing associates with deep conditions. The existing interrelationships between breathing and hypnotic state are tremendously useful both for the work of hypnotic induction and for the work with sportsmen to different levels, control of the breathing, control of the emotion, reinforcement of posthypnotic conditionings, works of imagery, etc.

2.2.4. Food system

There exist The present observations show that by using hypnosis, it is possible to increase or decrease the gastric activity by means of suggestions of enjoyment or of displeasure. The peristalsis also can be modified in hypnosis and therefore regulate the functioning of the intestines.

2.2.5. Secretions

All kinds of secretions can be increased by means of hypnosis. There are pieces of evidence to level of secretion of milk in women wet nurse. According to a classic psychological experiment of the onion that suggested in hypnosis can produce watering in the eye and both the salivation and the perspiration they are modifiable. These last two aspects to sport level can be very useful for the relation that they have with phenomena of anxiety and their regulation to competitive level.

2.2.6. Changes in the metabolism

An experiment that we all can realize: a person in the hypnotic state, we suggest him that he is going several days without eating. If in this moment, it was possible to realize an analysis of sugar in blood, it might observe since a decrease takes place in his measure and inversely, if we suggest him that he is eating a few fantastic sweets, there will take place an increase of his rate of sugar in blood.

2.2.7. Anatomical and biochemical changes

Numerous changes can be produced to the organic level across the hypnosis. One of the modifications that can have more interest with feminine sportswomen is the possibility that contributes the hypnosis of influence on the menstruation that can be induced or stop by means of hypnotic suggestions.

2.3. Phenomena associated with alterations in the sensory organs

2.3.1. Hyperesthesia

It refers to an abnormal or pathological increase in sensitivity to sensory stimuli of the sense. In a hypnotic state, variations can be perceived in the texture and the temperature that under no effort are perceived in the ordinary state of conscience. The applications are very useful for sportsmen to level of works of feedback corporal in different procedures of training control.

2.3.2. Hypnoanalgesia

It is the possibility of producing inhibition or absence of the sensibility to the pain. This applicability is of tremendous usefulness in competitive sport, in extreme moments. In fact, I had the occasion to facilitate to gain a final of championship of the world in martial arts to individuals with torn bones.

2.3.3. Hypnoanesthesia

It is the possibility of producing the absence of sensation by means of hypnosis of partial or total form. The usefulness to level of sports injury is obvious. The degree of induced anesthesia depends on the level of hypnotic depth; according to the electromyography study, the pain is in the body and the hypnosis what he avoids is the conscience of the pain. Owing to this situation, nobody might fall down in the mistake of abusing this possibility, the pain it is necessary to treat it since the hypnosis does not treat it, only he avoids this sensation. Equally, the pain is a mechanism that it warns to the body and it marks limits. For it to use this possibility with liberality in combative sports might be dangerous, and this would be one of the few disadvantages that the hypnosis shows, though it would not be due to it but if to a bad utilization and to the ignorance psychophysiological of the hypnotist. For it, the hypnosis only must be used for professionals qualified.

2.3.4. Paresthesia

The paresthesia is the abnormal skin sensations. There are very easy of elicit especially those of the senses of the vision, the taste, and the tact. It is not difficult to give a person, in hypnotic state, a glass of water and to say to him that it is a juice of orange. The person will taste the water as it will be a juice, not because the hypnotist controls the will of the individual but because the person arouses the flavor of the orange and processes this type of taste, not that of the water that really it consumes. It is possible to make the same thing to olfactory level

suggest the smell of a perfume before an onion, etc. The applications of the paresthesia are very useful to train the sportsmen to level of mental test, visualization.

2.3.5. Elicitation of positive hallucinations

The positive hallucination is the sensation of an experience without the real existence of the sensory corresponding stimulus. The hallucinations can take place in connection with any of five senses. The positive provocation of hallucinations in hypnotic condition has a great usefulness to realize some cognitive trainings with the sportsmen.

2.3.6. Elicitation of negative hallucinations

The negative hallucination is the absence of sensation of an experience before the presence of the sensory real corresponding stimulus. The problem of the negative hallucinations is that they are possible in general in deep conditions of hypnosis, and therefore, only they are useful with a very minority of population.

2.4. Psychological phenomena associated with the cognitive, emotional activities, and the ideational processes

The psychological phenomena that are given in hypnotic condition are numerous, only we are going to describe some of the most common and useful.

2.4.1. The effects on the memory

All the memories are stored in the brain and the majority of them can be recovered stimulating suitable routes of association. In hypnosis, individual can recover numerous information which they does not have remembrance in ordinary condition.

2.4.2. Hypermnnesia

It consists of the recovery of information or increase of the amnesic capacity beyond the ordinary possibilities. Nevertheless, it is necessary to be cautious with the information since they can suffer the distortion of the time if they are distant recollections. Useful for the recovery of cognitive information to level of results to obtain technical details or biomechanics of the occurred process.

2.4.3. Reviviscence, regression, and progression in the time

In the reviviscence, the sportsman can analyze an event spent in equal conditions that when it took place really. All the memories later to the event are annulled. It is a phenomenon similar to the hypnotic regression. A form of psychological activity implies the disorientation of the person and a reorganization of his perceptual balance with specific reference to the perception of the space time. The progression in the time is a strategy of great sports. To lead their imagination to a competitive future moment with apparent reality, it is interesting to develop

strategic works, of familiarization, of motivation, of competition simulated for study of specific behaviors, and for the comprehension of how the sportsman will react to potential future situations in that we are interested.

2.4.4. Time distortions

We all have in the brain is a clock that is capable of estimating the passage of time with excellent precision. Many people possess this particular faculty in their ordinary life. In hypnosis, any individual is capable of judging the time with an extraordinary precision, but also there exists the possibility of condensing or expanding the time, this is what is named as time distortion. A minute of subjective time can be compared to 10 minutes of (chronological) real time and 10 minutes of chronological time, they can be condensed in a minute of subjective time. The applications of the effect time in hypnotic condition are very useful in sports where the time of execution is very important; allow a technical very profitable complementation of the training.

2.5. Posthypnotic phenomena

The behaviors or responds persist once removed the effects of the hypnotic condition. Normally, there are answers to specific suggestions realized in hypnotic condition with the premeditation of which they last once finished the experience in hypnotic condition, when the person is to ordinary level of conscience. A major comprehension of this type of phenomenon we can have to pedagogic level using similarly the reflection determined the theory of the learning. The determined reflection and the posthypnotic conditioning are similar phenomena, if we exempt that the posthypnotic conditioning is not fixed by repetition of the stimulus and consistent learning, as he manages in the classic theory of the conditioning. The posthypnotic condition is fixed normally in an alone session of supposed learning, its activity is more prolonged to level of temporary duration and not extinguish so rapidly as a conditioned reflex.

3. Biofeedback

Biofeedback system is a term that is used for naming a set of technologies that aim to provide the information necessary, which allows us to exercise a degree of voluntary control on physiological functions. The devices of biofeedback provide immediate information about the biological situation of the individual: muscular tension, temperature of the skin, conductivity, blood pressure, and activity of the cerebral waves. Using the information that these devices of record supply psychophysiological, we can be trained to modify voluntarily the physiological measured activities. In the case of the brain, the goal of neurofeedback is to encourage us how to control the cerebral waves. The waves of the brain have qualified in four types: wave beta (waking states), alpha (states of relaxation), theta (drowsiness), and delta (deep sleep). This system of a natural way, without external manipulations, helps to control the electrical activity of the brain. When the learning of the wave control has already developed, it is not

necessary to continue using the devices of biofeedback and it is possible to train oneself without external models as an experienced meditator.

The procedures of biofeedback imply a special application of the concept of feedback to monitor and control the physiological processes. It uses the specific instrumental systems that allow to arrange a several type of sign related to some physiological functions, so that the individual could use this reference and learn how to control the function or physiological specific functions. This system allows to show them their aptitude to handle functions that are not subjected to voluntary control, leading them from this form to before unthinkable levels of self-control and control for the own person. On the other hand, the biofeedback allows showing the effects that diverse conducts so many cognitive behaviors have on their physiological responds. Thus, efficiency and facility are possible to help to reorientation with great more inoperative customs and senseless conducts that can affect their performance and that due to the automation on the part of the own person harm his possibilities without conscious awareness of doing so. Finally, the biofeedback facilitates the study of the physiological responds involved in the concrete tasks of every sports or artistic specialty and by means of these programs, training can be designed specific and highly specialized programs of training of self-control of physiological responds involved in the sport that the person practices.

The development and evolution of the biofeedback originated at the beginning of century, in 1901 [13]. Although until the beginning of the decade of the 1917s, the term biofeedback is not generalized, the technologies of biofeedback arise in the 1916s from the paradigms of the learning. The most important precedents that we might indicate are, first, the studies of operating conditioning of the cardiac human beating; second, the study of the resistance of the skin; and in the third place, the animals submitted to it will recover and finally the studies on control, by means of feedback, of the pace alpha of the human electroencephalogram (EEG) [14, 15].

As we have indicated previously, the principal aspect of the biofeedback is to facilitate individuals to learn the control of diverse corporal processes, in which most of the individuals not exercise controls. The investigations with human beings found that it is possible to control the activity of the cerebral rhythm, the galvanic response to the skin, the cardiac rate, the blood pressure, the peripheral traffic, the corporal temperature, the muscular tension, the external sphincters, the rate of the salivation, and the gastric secretion.

To be able to use the procedure of the biofeedback, there are two indispensable elements of great importance: the first term highlights that when any technology of biofeedback applied, it asks the voluntary collaboration of the subject to which it is applied from a sportsman. The technology doesn't work with unmotivated subject since the instrument or machine only provides the information in the case of not available sign. With the help of the psychologist, the individual must develop the control mechanisms. In the second term, for the utilization of these technologies, there is indispensable the availability of a suitable instrumentation, which must fulfill a series of requirements: first, a few conditions guaranteed of validity and reliability required for any device of measure. Second, a few minimal conditions relative to the process of detection of the sign, process that it is necessary to carry out of not invasive form,

with a high sampling rate, or in constant detection but so that it does not influence to the own system that tries to measure up. Finally, it is necessary that the own registered sign must be of low latency, so that it reflects linearly the physiological changes.

The biofeedback can be described on basis of phases that constitute the process of control, these phases are the same that has the record psychophysiological, with the difference of which into the last phase, the registered information is simplified and transformed to make them intelligible to the person. Later, we are going to realize an approximation to the principal psychophysiological responds that can be in use in psychology of high performance.

4. EEG: brain recording

The electroencephalogram measures small electrical potential activity of the brain through electrodes placed in the specific points of the head. These potentials were discovered by Hans Berger in 1929, and they have an assessable relevancy since unlike other psychophysiological responds that we will analyze that they reflect the activity of the nervous autonomous system, the EEG is the only direct index of the activity of the nervous central system.

The most commonly used electrode placement system is the international system 10–20. One of the basic parameters of the EEG is the frequency that shows the most relevant information and of more interest for the professional practice. According to the frequency, which different from 0.5 to 60 Hz, the EEG shows different rhythm known as types of waves:

- Delta rhythm: between 0.5 and 4 Hz
- Theta rhythm: between 4 and 8 Hz
- Alpha rhythm: between 8 and 13 Hz
- Beta rhythm 1: between 13 and 20 Hz
- Beta rhythm 2: between 20 and 40 Hz
- Gamma rhythm: frequencies higher than 40 Hz.

The principal areas of study and application of the EEG are the conditions of activation and sleep, the conditions of conscience, the self-control of the rhythm alpha and the evoked potentials. The evoked potentials have enormous applications at sport level to measure times of reaction and speed of transmission of the routes afferent and efferent, very important aspect in the selection of sport talents.

4.1. Electrical activity of the skin

The electrical activity of the skin or electrodermal response is one of the mostly used psychophysiological methods. The resistance of the skin is the impediment that puts the skin to the step of the electrical current, the resistance of the skin depends on the perspiration that covers the zone in which it measures up. Sweat is a saline solution that facilitates the electrical

transmission to more perspiration, minor resistance. We can deduce that the resistance is an inverse measure of activation with major activation, the major quantity of perspiration will reflect a low resistance.

The conductance, it is the inverse measure of the resistance, is a much more comfortable measure which shows a direct relation. The stronger the activation, the stronger the conductance (and weaker the resistance).

The mechanism of the appearance of the response to the skin is based on psychogalvanic in which the stimulus activates to the subject producing a widespread unload of the nice system, with what there is liberated acetylcholine at the postganglionic neurons that innervate the sweat glands. This produces a depolarization and momentary break of the cellular membranes allowing the flow of ions and the consistent decrease of the resistance or increase of the conductance.

The glands of the sweat that are the based on response of electrodermal are the eccrine glands (not the apocrine glands) that are distributed by the whole body, being their major density in the feet and in the palms of the hands. Two routes activate the eccrine glands by psychic stimuli and thermal stimuli. The activation for thermal stimulation is practically despicable in hands and feet, because of it the best place to connect the electrodes is in the palm of the hand.

The most common application of psychophysiological response is to control self-emotional of sportsmen

4.2. Cardiovascular response

The heart is a muscular organ with four chambers and its principal function is to supply blood to all the body parts. The branches of the nervous autonomous systems regulate the activity the heart:

The sympathetic nervous system increases the cardiac rate and the vascular pressure. The parasympathetic nervous system decreases the cardiac rate and the vascular pressure.

There are different types of cardiovascular activity to study the level of cardiac activity; an electrocardiogram (ECG or EKG) is obtained from the electrical sign. To evaluate the level of vascular activity, temperature (to major temperature, major level of blood exists circulating), color (reddish and pale, they allow us to identify major or minor flow of blood, respectively), volume (to major volume, major quantity of blood), and the pressure (to major pressure, major quantity of blood) are used.

The source of the electrocardiogram is the electrical impulses that the heart produces in every beating. When the heart contracts it changes potential the order of few microvolts, which can be detected in the walls of the chest next the heart but which also spreads across arms and legs.

The principal psychophysiological measures that stem from the electrocardiogram are the cardiac rate (a number of pulsations or beatings per minute or unit of time) and the cardiac period (interval of time in seconds between two pulsations). These measures are very useful in sport since they are indexes of the activity of the nervous autonomous system, by means of the EKG, tonic changes can be studied so much as phasic.

4.3. Electromyography response

The electromyography response, EMG, is a response of the somatic system that reflects the electrical activity of the muscular fibers.

The electrical changes that take place in this process of depolarization can be detected and provide a measure of the muscular activity which is more relevant than the simple mechanical direct records of the muscular tension.

Overall, the EMG is a technology of measurement of the electrical potentials that are associated with the muscular fibers. The muscular activity can influence emotional and motivational factors, and as such, it is an excellent measure of evaluation of the level of easing and activation of sportsmen, the zone of record normally used with this finality is the frontal muscle.

4.4. Body temperature

The temperature of the skin is regulated fundamentally by the vascular peripheral system to realize biofeedback with this sign. To measure the peripheral thermoregulation of the sportsman, we can use thermometers or, indirectly, transducers, a type of the thermistor, which turn the temperature into electrical sign. The corporal temperature, it also uses in some cases, is an indirect measure of the blood flow.

A methodological requirement to use the thermal feedback is the control of the environmental temperature in the place of capture of information, besides the temperature, before which the subject has been submitted. The temperature during the record should be kept constant ($\pm 2^\circ\text{C}$), if this margin excels itself, there would be restricted to the subject the range of elevation of the peripheral temperature.

Another fundamental aspect is the suitable placement of the sensor. The most suitable location is on a zone of great vascularization, trying that the sportsman in this zone could not exercise any type of pressure, otherwise, it might falsify the measure. The corporal temperature is an index witness of activity of great usefulness to verify the effect of mental-specific trainings for the sportsman.

4.5. Respiratory response

It is an important measure of record for the sports biofeedback; it is composed principally by two parameters, the depth of the breathing and the respiratory rate, which they are combined in order to obtain the volume of air inspired per minute. The respiratory function is controlled by the nervous central system across the spinal cord, and the motor nuclei of the brain stem and its psychological importance take root in that it is easily influenced and affected by the emotional conditions. The breathing has two fundamental periods: the inspiration or air capture and the expiration or expulsion of the air.

There exist different methods of measure of the electrical activity; all of them are because of the physical nature of the sign that needs some type of transformation or sign. Another methodology of record used in psychophysiology is the so-called method of displacement of the zones involved in the breathing. The displacement of the thorax measures high as much

as that of the abdomen. The form of measurement is variable. It is possible to realize placing a spring in the thorax and abdomen, which needs the immobility of the person. Also, placing an elastic strap translates the stretching in electricity. A positive aspect of this methodology is that it allows distinguishing the thoracic breathing of the abdominal one. This distinction is important since to major level of anxiety, there is major level of thoracic breathing and contrary to major deactivation level of abdominal breathing.

4.6. Gastrointestinal activity

The gastrointestinal activity is very sensitive to the emotional changes; therefore, its measure is very useful. There exist three principal measures of the gastrointestinal response: the gastric motility, the stomach acidity or level of pH, and the salivation.

The classic technologies of record of information to this level were very invasive; it is enough to remember the gastric pipe introduced to the person to gather inhaling the stomach content or the pipe with an inflatable ball in an end to measure the intragastric pressure. Nowadays, the methods are evolving rapidly, and it is possible that in the future, this type of record is furthermore useful to sports level of field. Recently, they have turned out to be technical more sophisticated as the radio telemetry, which operates across a radiotracer that the person can swallow comfortably, and that by means of the corresponding transducers convert the measure into electrical signs.

The measure of the salivation is interesting because three couples of glands salivate existing (parotid gland, sublingual gland, and sub-maxillary gland) are innervated for the sympathetic and parasympathetic nerve fibers, and therefore, they reflect the activation of the system. The saliva in situations of fear and guilt suppresses its secretion. In stressful situations the assertive individuals increase the level and keep out they diminish it. To level of composition in conditions of anxiety, it is less alkaline.

4.7. Pupillary response

The ocular answers are another type of the psychophysiological record that are very useful, but probably not too widespread motivated by the sophistication and economic cost of the set of instruments used. Fundamentally, we use the ocular movements and pupillary activity. The ocular movements are saccades. The methods used to measure the ocular movements are two types: electrical and nonelectrical types. Between the nonelectrical ones, it is necessary to stand out the ophthalmoscope, which is based on the reflection of the light on the cornea, and the most indicative electrical level is the electrooculogram (EOG).

The pupillometry is the technology of the measurement of the pupil diameter. The pupil is an opening across the iris, the function of the iris is to increase the diameter of the pupil in situations of scanty light and to diminish it in situations of abundance of light. The pupil can contract 1.5 mm and expand 8 mm up to 0.9 mm, these reactions be generated in 0.2 second. The changes in pupil also response to psychological stimuli, to take records the lighting it has to be a constant. The unit of measure is the millimeter and reflects different aspects that are important in the sport. The diameter of pupil is maximum when the sportsman is resting and

diminishes when one is getting tired. As for the task is more complex the diameter of the pupil gets bigger. The expansions of pupils are also an index that reflects the changes in the activation of the nervous system. Though probably these methods seem to the sports technician slightly operative, to level of basic investigation, they represent indexes of great usefulness psychologically sports.

The application of the biofeedback to control and prevent sports stress has been an important evolution of the systems of training. The psychology contributes with the biofeedback an indispensable tool to bring over the sportsman and the artist to their maximum possibilities of performance.

In previous decades of last century, we had the fortune of starting investigating the first applications of the emergent virtual reality at the time to the field of the psychology with applications in the environment of the high-level sport area that, due to the strong social and commercial interest that it supposes was allowing the development of new technologies and applications, because numerous possibilities of financing existed especially before the celebration in 1992 of the Olympian Games in Barcelona. These circumstances allowed us to develop the first applications of the virtual reality in the athletes' training of high performance [16], developing new methods to reduce the anxiety, to facilitate the technologies of mental test and to overcome specific phobias that though they raised the attention of numerous mass media, they supposed skepticism, incredulity, and their funniness [17]. Today, decades later, consolidated the new technologies in our society like something daily and natural and with an abundant scientific international bibliography; it is possible to treat the topic without problem.

The dancers are athletes of high performance who in general do not compete, but they train and have a way of life very similar to the great athletes with the aim to reach the virtuosity in the artistic expression. Unfortunately, the world of the art has neither the technology nor the scientific accompaniment, nor the profit budgets of other activities but provided that the developments are there and are an own property in the investigation that we are developing in the king juan carlos university (KJCU), of applications of the information and communication technology (ICT) in the arts, we have started introducing systems of application of technological innovations of forefront neuroscientist to the area of the dance as the introduction of technologies of psychological training by means of systems of biofeedback and neurofeedback, and as a tool of increase of the artistic performance, we have started using the virtual reality in this area.

A definition of virtual reality is very complex. It is a technology that is in full boiling and exists decades ago, but the large changes that are taking place in the technological evolution and the wide range of designed systems do not allow us to offer a definitive definition. The term had its appearance in the year 1988 attributed to the visual artist and composer of classic music Jaron Lanier [18] founder together with Thomas Zimmerman of the company VPL Research Inc., the first company that sold glasses and gloves of virtual reality at the end of the decade of 1990. Nevertheless, the experts mark its origin in the decade of the 1960s, when Ivan Sutherland developed "a head-mounted three dimensional display" a development that was demonstrating that it was possible to combine three-dimensional graphs generated in a computer with interactive visualizations.

The VR is defined as a method of interaction between the user and the computer, in which user stops being a passive person that receives images and information on the screen and turns into an active being and starts interrelate with a three-dimensional environment. So that the technology VR supposes two new questions between the man and the machine, the possibility of interaction with what there is generated the illusion of being physically inside the virtual space because it interacts real time. This illusion is named as a sense of presence [19] which allows that the user could have reactions and to evoke emotions very similar to those that it has in the appropriate environments, of their stems, efficiency, and big possibilities of utilization in clinical areas, allows to simulate the reality of a convincing way for the brain, beyond the utilization of the imagination that also has its paper of reinforcement in the psychotechnology and is, precisely, what the VR turns into a tool of huge therapeutic potential and with enormous possibilities of being used in the training of artistic capacities. The first works in art we have carried out them with musicians, about a field that presents problematic many since is that of the scenic anxiety. At first, we were thinking that this one was not a problem that was affecting especially the dancers, but the accomplishment of some works of investigation and doctoral theses has showed us a very different situation.

An equipment of VR intervenes different technological components: a computer, a virtual environment, systems of input (to provide information of the actions that the user is going to realize, with sensors of position, systems of eye tracking that register in real time, the ocular movements and the most traditional devices such as the keyboard, the mouse, or a joystick, or the acquaintances and sophisticated gloves of VR), systems of output (those who stimulate the sensory channels of the user, the visual and auditory systems are most developed and are increasing of utilization the olfactory and haptic systems and are starting developing also gustatory system).

In the last years, the VR has started consolidating as a tool of great value for the professionals of the mental and physical health. Beyond continuing extending the range of psychological disorders in which solutions based on the VR will be implemented; one of the large developments will come from the Internet and of the mobile devices (smartphones, tablets, etc.). As a result of these decades of investigation, we already have very optimistic information that show the great clinical efficiency of the VR for the treatment of the most ample range of disorders of anxiety. In general, it is necessary to emphasize that the studies of the analysis of goal [20] indicate that the virtual reality exposure therapy (VRET) is more effective than the exhibition in imagination and, probably the most interesting thing, it is like a minimum as effective as the live exhibition. At present, the most robust information has been principally for the phobia to flying and the acrophobia. During the last decades, some authors have developed experimental procedures capable of producing emotional changes of a controlled way and of inducing states of mind. Based on the needs of the users of the area that we are treating, to assure the sensation of relaxation and to avoid sensations of anxiety, it has been verified that the VR has a high efficiency [21].

The works realized in the Applied Technology for Neuropsychology Laboratory of the Italian Institute for Auxology demonstrate these possibilities. In this institute, there has developed a qualified project "The Dream Island," with the aim to use this technology to confront successfully the stress and the anxiety so much in clinical population, as not clinic. They have developed an environment that is a tropical virtual island, in which the user can train in varied technologies of easing: as Schultz's autogenously training, Jacobson's muscular progressive

easing and different exercises of breathing by means of a protocol with two differentiated phases. The first phase is realized in a controlled environment, since it can be the office of the clinical person in charge where the patient is exposed to the virtual island by means of an equipment of VR. In this context, the user with the help of the clinical one tests the technologies of easing learned in the zones that consist the island. In the first zone, the user crosses a bridge that takes him to a beach, where it realizes the first relaxation technique opposite to the ocean. The second area is designed by a waterfall placed in a hill, where the user has the task of imagining that his negative thoughts go away close to the water of the waterfall while he trains in another relaxation technique. In the following space, the user can visit an atoll of the island in which there is a chair when he sits down can observe the tropical environment and the ocean while he practices another technology. Finally, in the last area, he entered a shop of campaign practical, while in another technology, he visualized the movement of the waves of the sea. A characteristic that differs in the VR of the traditional technologies, in which one is employed with the closed eyes, is that the user remains with the opened eyes and listens and sees directly a tropical island, so that the user forgets the space in which he is and has the illusion of being visiting a different space that generates an agreeable sensation of peace. To study the effects of this environment realized, a study with 38 university students assigned to three experimental groups, one work with an equipment of VR, other one with a DVD directed when easing provokes with images and sounds of tropical islands and the third group control the one that did not apply any relaxation technique to himself. The results indicated that the VR can be a very effective technology to diminish the anxiety [22].

Though the VR every time is a more attainable reality, the equipment has started popularizing and degrading drastically; there are companies that already have launched onto the market products of a quality very adapted to attainable prices, the big problem is that the environments, it is necessary to make them in proportion to what he needs. At present, they can find environments as the writing in the text on that we were commenting completely free. The Italian Institute for Auxology, leading by Doctor Giuseppe Riva, puts at the disposal of any person who it wishes diverse virtual environments without any cost in his web page (www.neurovr.org). Moreover, it is possible to use the publishers of video games 3D commercial that represent an option with an economic very moderate cost. In our technological projects, it is in production on the part of the University Institute Dance "Alicia Alonso," to put at the disposal of artists virtual environments especially designed for the representation of a ballet or to be a soloist in an important room of concerts or to realize a theatrical representation in an important scene of the maximum level, only we need to provide appropriate environment prototypes that we are generating, and to rely on more funds of investigation that they should allow to make real these projects.

5. Conclusions

The technologies of biofeedback have demonstrated extensively their efficiency for more than 50 years and their therapeutic application to various problems and clinical disorders, but there are still many questions to be answered concerning the efficiency of these technologies per se and, comparatively, with other therapeutic technologies applied to similar clinical problems with who often are combined to assure the best benefit of the patients.

According to a periodic review study in this field conducted by Yucha and Montgomery [23]—one of the principal available sources of information in the matter, supported by the International Association Applied Psychophysiology and Biofeedback—there exists an efficiency confirmed for aspects related to sport and high performance such as anxiety, attention, control of the pain, and regulation of emotions that ensure the utilization and the need of these technologies such as the commented in this writing.

It is necessary to continue research and improve the methodologies, but the basis is there, a present that consolidates these processes and a very promising future. The same thing occurs with other methodologies suggested in the writing as the hypnosis and the virtual reality, they have very promising applications, being necessary to increase the investigation to consolidate and to generalize their applications.

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