1.2 Systems Model and Athletic Training

Systems Model and its introduction in motor learning and athletic training

Athletic training has been markedly influenced by the mechanistic conception of the human being. Mechanism is a theoretical model that raises the following: the reality that surrounds us is comprised of a series of structures similar to those of a machine. That is to say, if the operation carried out by a machine is understood, then reality can then be interpreted or dissected just like we would with a machine to be studied. It is a reductionist philosophical conception, as it ensures that any reality or context must be analyzed according to models provided by machines.

Beyond the contributions to changing the dominant model and trying to introduce more holistic views, even today we are still governed by the Cartesian model, in which the human being is conceived as a set of pieces made up with parts, just like a mass-produced machine. The idea of individualization is extended, and though we are aware of the limits of the classical training theory when responding to athletes' constantly changing needs, training methods based on the reduction of the organism into smaller constituents continue to be applied (Torrents, 2005).

Since Descartes, science has taught us to study a phenomenon by dividing it into parts until it is decomposed at the atomic level. This led to the creation of academic groups specialized in the study of each fragment of each part of a being. Innumerable disciplines specialized in particular subjects have appeared since then: physiology, biology, anatomy, biomechanics. It was understood that this was the only way to analyze one particular phenomenon. Taking a case, breaking it down into parts and having each one of them studied separately by specialists of the respective areas.

The twentieth century saw the emergence of various theories which had a great influence over how science is interpreted. The living organism is conceived as part of a whole in constant interaction with the environment that surrounds it. Analysis models were developed and they modified the way of doing science in the fields of knowledge such as mathematics, psychology or economics.

These theories no longer focused on breaking down systems into smaller components, but rather considering them as a whole and focusing on the basic principles of their organization. These principles of organization are common to all systems and, in particular Complex Dynamical Systems, represent all living beings, according to the new research lines. This is how self-organization phenomenon appeared, linking similar cases under a general behavior pattern.

The dynamic systems theory aims to provide analysis tools that will not only be applied to high performance sports but also to the field of scientific research by contributing

concepts that had not been considered previously. DST was introduced in the world of athletic training to analyze how the athlete's motor behavior works, and thus create new lines of research. This is considered of great importance, since it makes it possible to understand how the learning and the organization of the body in movement is achieved from the study of motor skills (Torrents, 2005).

In order to improve understanding of the subject, we will start by defining "system". It is defined as follows: a set of two or more interrelated elements working together to achieve a common goal. The general systems theory, described by Ludwig Von Bertalanffy (1976), extended the systems proposition to all fields of science. Although Bertalanffy was a biologist and emphasized the need to formulate a mathematical theory, the general systems theory is primarily philosophical (Aracil, 1986). The development of this theory was driven by the need to solve issues with organization and order and to establish universal principles applicable to systems in general.

From the formal and mathematical point of view, a system is considered an entity formed by a set of elements, which are the basic components of the system, and by the relationships that exist between them and with their environment.

The general systems theory is the product of the history of philosophy and a method aimed to study, investigate and analyze reality. Its objective is to generate models that can be used to interpret a small part of that reality or of the universe, such models being parts of a more global model (Bertalanffy, 1969).

All systems are understood to be parts of the whole, that is the universe, which cannot be studied in isolation from the context of which they are part. Decontextualized reality is a reality which is not worth studying. We are gradually trying to understand how context determines what is intended to be studied.

One of the most important propositions for this theory is that facts cannot be studied as isolated situations after breaking them down into parts. We must understand, by contrast, that the parts interact, form a whole that unifies them and generate a behavior that cannot be understood if the parties are studied separately.

1.2.1 Scientific trends that start to interpret Systemic Theories

Biology began to question the consolidated reductionism, the division of organisms into parts, in order to emphasize the central idea of the whole, holism, the systemic or ecological perspective (Capra, 1996). The essential properties of a living organism or system will be properties of the whole, but of none of its parts, as they appear through the interaction between these parts (Torrents, 2005).

In psychology, the mechanistic vision of the human being and the man-machine metaphor started to be modified as a result of the emergence of new approaches, such as Gestalt psychology (Köhler, 1941).

This trend, which goes hand in hand with Eherenfileds, proposes that the "whole" is more than the sum of its parts. In this light, the "whole" becomes irreducible (it cannot be

broken down) and the organized systems evidence particularities, characteristics or behaviors that are absent from their parts. The conditions taking place in a certain area will directly influence what happens in another area, and so on, and vice versa. The Gestalt model proposes that the whole is definitely irreducible.

Henceforth, the decisive factor to the formation of units is the interrelation that takes place between the components making up these units, and not the properties of each one of the components (Torrents, 2005).

Quantum physics also takes into account the importance of interconnections. Capra (1985) describes it as: "The Cartesian outlook on the world is mechanistic; by contrast, the vision of the world that emerges from modern physics is organic, holistic and ecological. It could be described as a systems vision, in the sense of a general systems theory. The world can no longer be perceived as a machine formed by a large number of objects, but must be conceived as an indivisible and dynamic unit whose elements are closely linked and can only be understood as cosmic process models." (Torrents, 2005).

Cybernetics (Wiener, 1961) appeared in the 1940s as a new branch of science that raised various theories explaining the behavior of both machines and human beings. Concepts such as information, communication, reliability or trust and feedback were used. It focused on organizational patterns and on the self-regulation capacity of the system so that balance can be maintained. It studied the control systems taking into account the communication between the system and the surrounding environment, and within the system, the control of the operation of the system taking into consideration the environment.

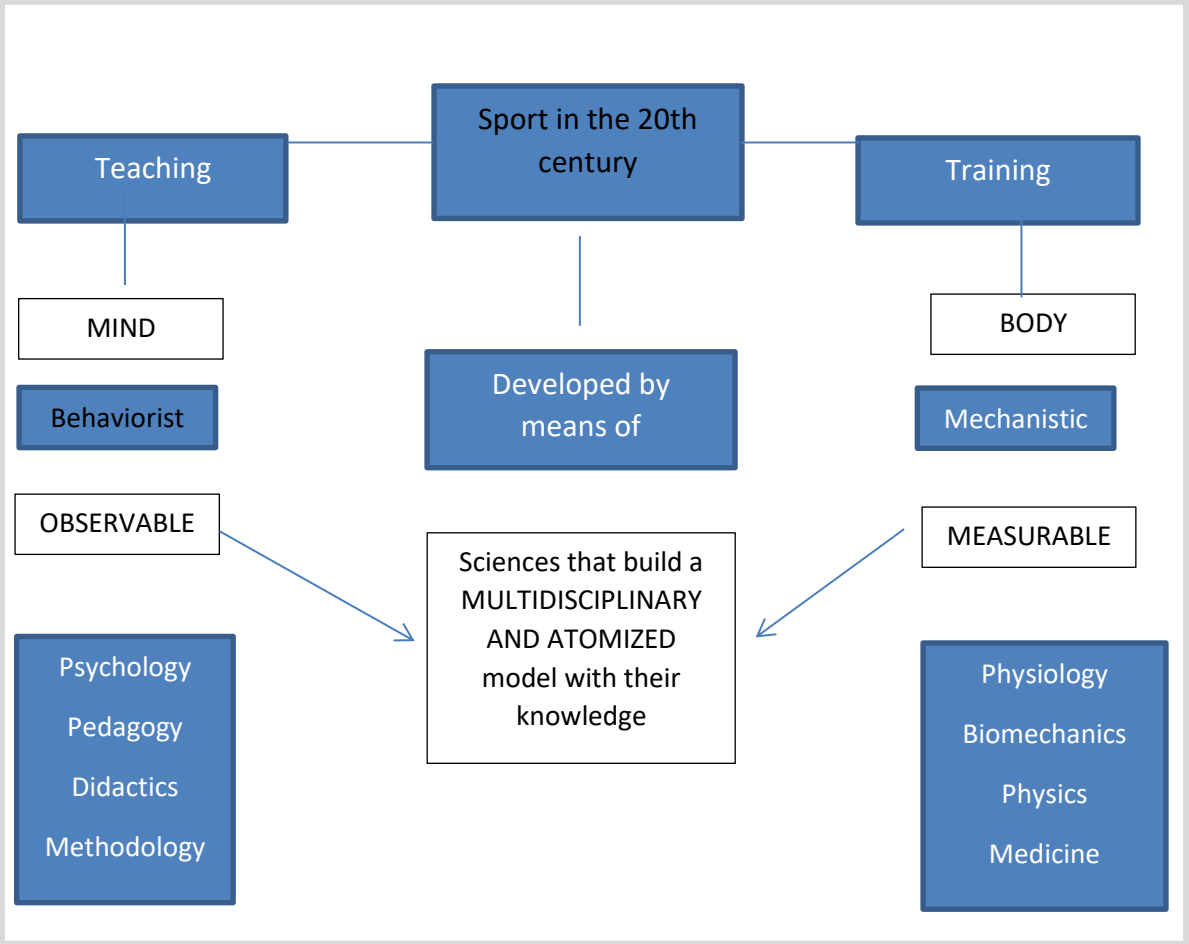
1.2.2 Dynamic Systems Theory and athletic training

The arrival of DST provides the opportunity, not only to improve the field of scientific research, but also to help us understand the motor learning variables. In this context, training proposals begin to change and to look upon the subject-athlete more as a global being in interaction with their environment.

This new perception aroused the interest of numerous trainers, physicians, physical trainers and researchers, who are generating knowledge based on these new trends. In the field of athletic training, it is commonly understood and accepted that the parts of an individual's body and the surrounding environment will influence the final behavior; it is indeed influenced by a network of systems (Sanchez. Uriondo, 2012).

The athlete is understood to be a global being in which multiple skills and conditions coexist simultaneously and which come together during each moment of sports practice. It is never a single condition at a time, they are all working simultaneously with predominance of one over the other, where the great challenge is precisely generating that kind of training to rise to the challenge of a context that is never the same.

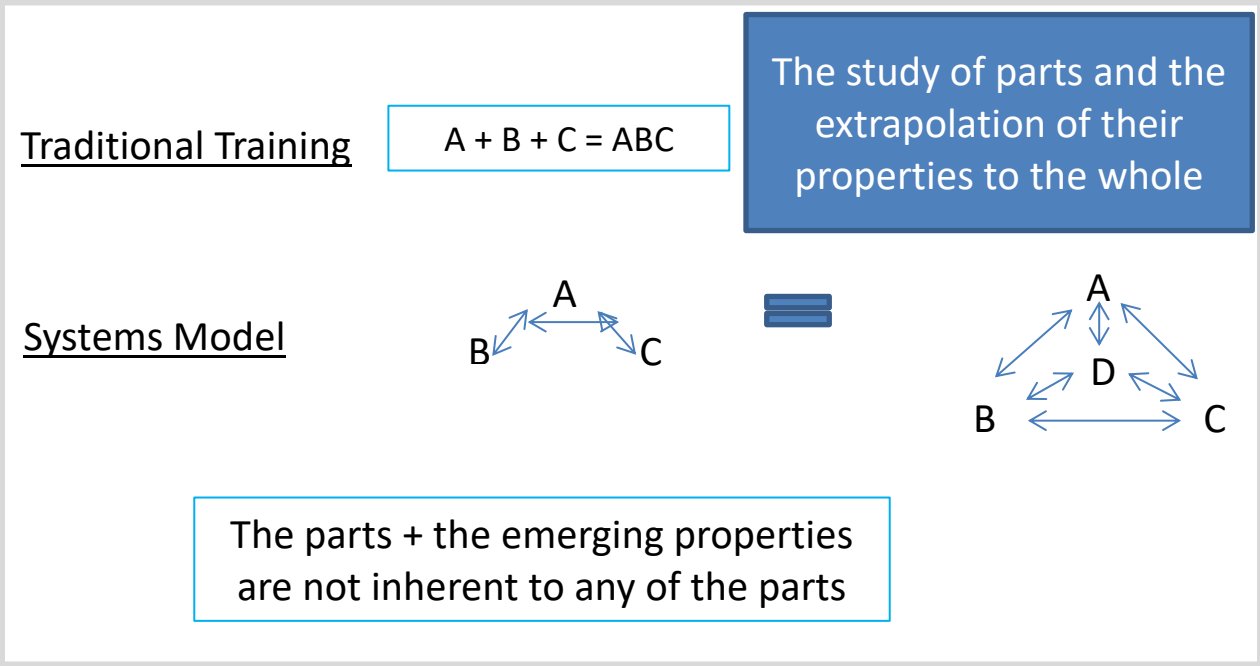
Figure 5: 20th century sports model



Source: Seirul·lo Vargas, 2002.

We must understand the subject-athlete as a complex and unpredictable being, who needs a training context that follows or is as close as possible to their reality. A reality that is never the same, because we never find ourselves in a moment that is identical to another. Repetition only adapts the athlete to respond in that way, we train the same stimulus hundreds of times, which must be applied in an always changing context. With this we teach how to respond and analyze the situation with few tools.

Figure 6: Traditional vs. Systems Model



Retrieved from Pol, 2012.

N.A. Bernstein is one of the authors who worked on DST applied to motor learning in the times where Paulov's claims predominated and dominated science in his country. Bernstein interpreted the coordinative actions as facts of great complexity, which is why he tried to reduce the large number of analysis variables so as to generate common patterns. Its objective was to reduce the levels of complexity to a limited number of variables which would be characterized by order and not by chaos and dynamics.

Bernstein identified the formulation of the motor program as the starting point in order to understand the movement of the whole organism and feedback as the main corrector for the dynamics of the motor action.

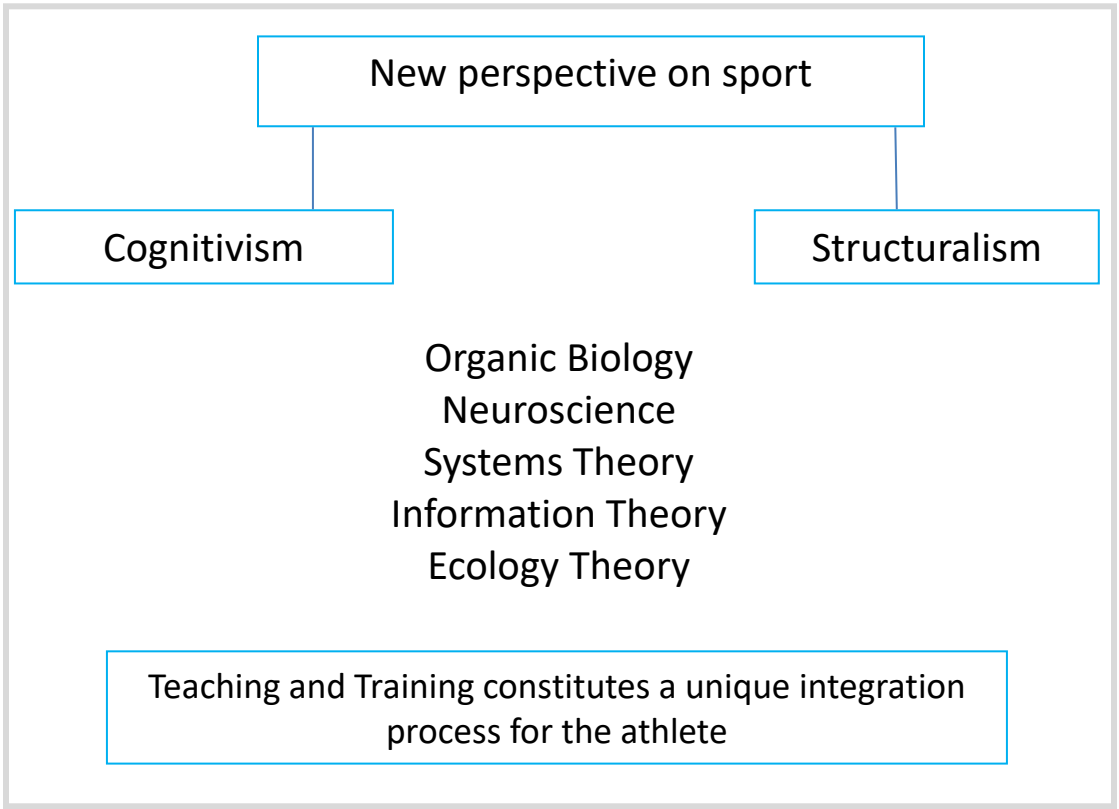
Following on with this author, we can say that motor coordination incorporates the relationship between the different levels of the organization, components and functional states of the motor system (internal coordination), as well as the relationship between the motor system and the possible objectives and events of the environment (external coordination).

Integrated training emerges in the field of sport. This is where the technique and tactic of the sport being studied are used as the foundation to refine physical, psychological and visual abilities and aspects. Hence the name of integrated training.

Authors such as Verchoshansky, García Manso or Ruiz and Sánchez Bañuelos use these terms when referring to training. They state that the athlete's behavior cannot be decontextualized; on the contrary, it must be integrated into the environment in which it occurs. Motor behavior can no longer be explained only from a biological standpoint. The integration of the variables will constitute the determinants of the athletic success (Torrents, 2005).

Some authors, Sole (2002), suggest that there are currently two different training analysis perspectives: biological perspective, which is based on an analytical perspective that studies the phenomena related to the performance in isolation; and the holistic perspective, that comprises the athlete's global preparation processes, as a product of interactions of diverse aspects that are involved in athletic performance. The first trend corresponds to what is performed in a laboratory, while the second corresponds to field work performed through a joint analysis of performance-related phenomena. However, increasingly field work is being performed in biology, and probably both perspectives can be complementary.

So far, with the review of this bibliography we want to stress the importance of analyzing the athlete from all angles, and not only from a unique perspective, giving priority to enhancing and increasing athletic performance. Biology, physiology, physical preparation, psychology, etc. can be studied separately, but if this is done in an integrated and interrelated way, it is possible to achieve greatly improved performance results: "The whole is more than the sum of its parts". If professionals from different areas who work with athletes were to internalize this principle and they started working with this objective in mind and for the player's benefit, they would increase their knowledge about the athlete, as well as their analysis and evaluation abilities, since they would expand their repertoire of teaching methods, and would therefore design exercises from a holistic perspective.



Source: Prepared by the author

1.2.3 Structure model

Following on with this model of analysis and in relation to what DST proposes and the multiple authors that write about it, we can understand how a methodological process for sports education is established with all this in mind.

An athlete who needs to improve a specific athletic motor pattern, a shot on goal in soccer for example, is trained according to the classical methodological current, with the analytical method. This motor pattern is broken down and studied as an isolated element and with an analytical approach. In short, in a linear way, under the principle where more of the same is better. If the problem is the shot on goal, the shot is practiced understanding that its improvement will be proportional to the amount of practice. It is decontextualized and isolated from the whole, that is the game and its environment, in order to practice it in an isolated setting independent of the context in which the action unfolds. The training proposal was conceived this way, as a result of the way science looked at phenomena in order to analyze them. According to this perspective, the context does not play any role, nor does it determine or influence the subject-athlete.

This athletic motor pattern, trained under the current methodological approach of dynamic systems, will be worked on based on the reality that characterizes the motor pattern. In other words, training is carried out where the movement takes place, under the conditions in which it is executed, with the different structures which may be involved in that kind of situation and which together make up the subject-athlete. These structures have been defined by Seirul·lo Vargas and will be detailed below.

- Socio-affective structure: Gives the subject the chance to propose, interpret, and evaluate any situation of interpersonal relationship observed or experienced in the multiple situations shared with the components of the sports groups where he is involved.

- Emotional-volitional structure: It is the personal identification of oneself. If the subject-athlete does not believe in the training process they are executing, a negative feedback loop is produced, which will hinder or prevent their progress.

- Creative-expressive structure: It is when each athlete brings their share of different individuality to the task performed. The individual is understood to be part of a previous learning history.

- Cognitive structure: It is responsible for collecting and processing the stimulus that the player receives from the environment to identify the possibilities for action. Contextual information processing.

- Coordinative structure: It is responsible for the execution of movement in the desired way. It is the motor control of the action, for both the spatial characteristics as well as the temporary elements of said action.

- Conditioning structure: It gives physical support to the development of the player. Its most representative values are related to the classical concepts of strength, velocity and endurance.

These structures are composed of systems and subsystems that interact and interrelate with each other, producing as a result the subject-athlete's behavior. This interaction is, in turn, the product of the environment-context in which the motor action unfolds. Therefore, we can observe that from this perspective, the subject-athlete is trained considering that they are a complex structure formed by systems and sub-systems interacting with a context that is in turn composed of micro-systems, meso-systems, exo-systems and macro-systems which will influence each of the motor actions executed.

1.2.4 Reflections about the new generational trends and their impact on athletic training

Earlier in Unit 1, we saw how younger generations are often quick to break down the walls, allowing these new theories to be formed. We will take an example of what happens every day in the field of sports practice. These examples are taken from cases provided by the coaches themselves in our daily multidisciplinary work sessions.

One of the most important characteristics of these new generations is the unlimited connectivity with the world via the Internet. The multiple social networks allow them to know what is happening in every corner of the planet at any time. Educators must then deal with a group of subjects who, on many occasions, not only know what we are talking about, but also more thanks to their adaptation to the connected world.

On many occasions, the groups of coaches have come with questions such as: the children know all the sports practice exercises that we do, they watch videos of another club's training on the Internet and they tell us that our exercises are not very motivating.

Nowadays young people have seen everything they want to know about their favorite sport, they watch the videos of their idols, how they train and what children of their own age do in the world's most important clubs. Then, with all that information, they find themselves with a trainer that is not up-to-date, and this leads them to express to the coach their requests for more interesting exercises. The same happens in all educational areas, perhaps more intensely in the realm of sport, because it motivates children more. Therefore, in addition to what has been studied throughout the module on theoretical currents, another aspect of sports psychology to work on and take into account as professionals, is how to adapt to the new generations and everything they demand from us.

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