1.Train - optimize

1.1 How do we train?

The methodology used for the learning process is of paramount importance, as it determines the kind of learning the player will have and the related skills he/she will gain. The methodology must be closely related to what you're trying to optimize.

Learning methodologies vary according to the objective pursued: it is not the same if the aim is for players to learn specific game situations and how to solve them, than if the objective is to prepare players to adapt to changing game environments.

In the first case, the session will be developed through repetitive exercises that simulate a specific situation. For this situation to occur, the coach must stop play at the end of the action, allow time for the players to return to their starting positions, and repeat it. The positions and actions carried out will be determined by the coach. The situation is created, and with it, the solution needed to achieve the objective of the exercise. With each repetition, these actions will become "automatic" for the player.

In the second case, the methodology is the one used by FC Barcelona. A real game context is created, with constraints so that something specific that we want to optimize occurs naturally. It is not always going to work out, and when it does, it is not going to be in the same exact conditions. The player will have to adapt to a changing environment in which, at certain times, the objective to be optimized will appear. Our methodology is characterized by:

- Guided discovery (or unguided, if the players are already experts in the situation at hand) during the session. Usually, the players are given some time without any intervention by the coach, who limits him/herself to observe and record the behaviors that emerge in the situation. Through guided discovery, the coach and the player must interpret the reasons why a certain movement was generated; they discover it together.

- It is experiential learning. Our way of getting players to optimize their game is to put them in that context so that the necessary motor actions emerge from them. After an action, we help the player with some pointers, if we consider it necessary. Let's not forget another important type of learning - declarative learning,

which is necessary for reflection processes that lead to a greater understanding of the game.

- We also have implicit learning, as a consequence of the above, since the player is not aware of the content or objectives he/she learns, at least not at the time of training. Although it is necessary to inform the player of the objective of the session or exercise. This new paradigm will be something like: "to be efficient in high-pressure situations in numerical equality", and not: "to play with a third player in order to escape the high pressure in numerical equality". Although perhaps the constraints of the exercise are aimed at creating play with a third player. Also, after the exercise, we review what has been achieved, and this is where the declarative learning comes in.

- Non-interventionist. The coach is not the center of the training process just because he/she is disseminating knowledge to his/her players. Instead, after explaining the exercise, he/she mainly observes, and asks the players about actions they perform, to jointly determine if it would have been better to make another decision.

These four points are necessary to understand the "Complexity Theory" applied to collective sports training. It would not make sense to design an exercise based on constraints and then explain at the beginning of the exercise exactly what the player is supposed to do; or during the exercise, to instruct the player to do what the coach, from his/her point of view, thinks is best. In other words, the training methodology, the coach's intervention style and the design of the exercise must be closely linked. If one of these three elements is not in line with the needs of learning in complexity, the learning process as a whole will be drastically affected. It is quite common for coaches to be trained in the design of exercises, but not in the style of intervention, which is often determined by the coach's profile. Modifying it requires an introspection that many coaches do not do because, in part, there is no awareness that this modification is necessary. It is implicitly accepted that the coach must "teach" the players.

At the same time, our holistic view of the training process alerts us to the fact that there will be situations in which more explicit or more guided learning is necessary, such as a training session needing less cognitive load or a specific action to be optimized needs to appear more often. Sometimes the coach needs to intervene more during a certain exercise perhaps because he/she needs the players to believe in him/her and sees the need to reveal his/her knowledge during an exercise. Other times, the coach will lead exercises that are easy to execute because he/she believes it necessary to perform simple exercises to give confidence to the player. These cases and many others are motivated by reasons that do not exclusively belong to the learning process, but to group

management, management of training loads, etc. Therefore, we believe that the methodology is flexible and depends on multiple factors, but we base training on this methodology and modify it towards a more interventionist and less global style in specific moments, and not the other way around.

Optimize

It is understood that one of the main objectives of sports training is "performance optimization". We will explain this term in further detail in order to understand what the idea of optimization refers to.

Torrents Martín (in Balagué Serre and Torrents Martín, 2016) maintains that in the field of science (engineering and robotics), optimization refers to the improvement of the performance of a given operating system. These systems are complex (they were referred to throughout the program). The caveat in these systems (for example, in robotics), in comparison with neurobiological systems, is that they try to program movements that can then be reproduced (repetitive), and in this way the systems are considered optimized.

Despite seeking to improve performance through optimization, neurobiological systems are versatile and adaptable, which makes them complex and, given their characteristics of metastability (changing stability), they never reproduce the same movements. This is transferred to the individual and group level. Adaptability is a variable that causes the system to survive in changing environments.

Balagué Serre and Torrents Martín (2016) argue:

> The behavior of a biological system will be optimal at any time, as it will be in relation to immediate constraints. Thus, it is asserted that the system always behaves the best it can. From the perspective of complex systems, optimization refers to an adequate coordination and coupling of components and constraints, both internal and those related to the exercise and the environment, as well as an adequate exploratory capacity to find creative, effective and efficient solutions in changing environments (Balagué and Torrents, 2016, p 37).

Exercises and optimization

During the training process, coaches have two ways of getting the message across to the players, namely through "the exercise" and "the intervention style".

By creating "Preferential Simulating Situations" (PSS), subjects are allowed to play and feel the experience of the chosen game philosophy.

The constraints of the PSS must make autonomous, efficient and effective behaviors emerge in favor of the nature of the player.

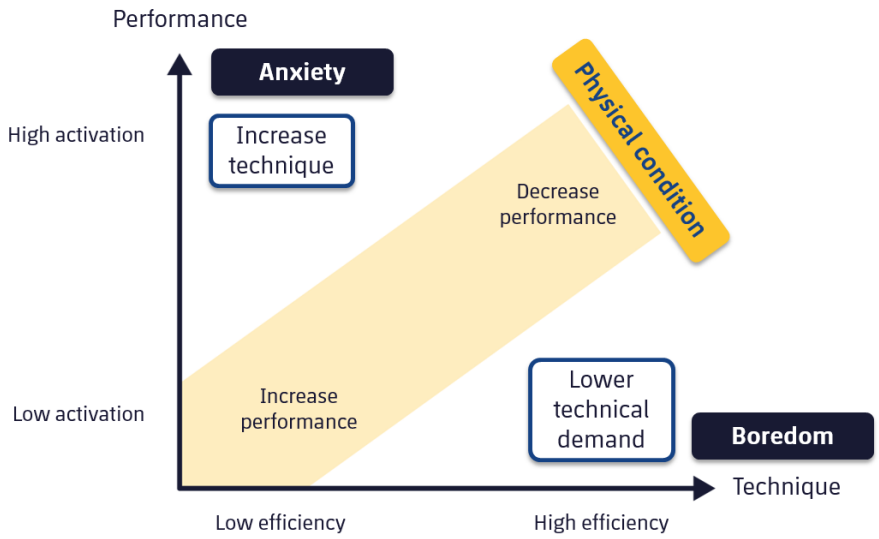
"The exercise is the direct communication channel with the athlete in order to interact, modify motor, cognitive and conditional schemes, change behavior and, in short, shape the process of optimization of athletes" (Serres, in Seirul·lo Vargas, 2017 p 196).

The design and elaboration of exercises are very important pieces in structured training, as they are part of the optimization process of the athlete from the paradigm of complexity. In this regard, Espar states: "the exercise will be the key to modifying the athlete. The exercises must be adapted to his/her needs, knowing that these will change continuously throughout his/her sports career." (Espar, en Seirul·lo Vargas, 2017, p 244)

One of the definitions of "exercise" that comes closest to the philosophy of complex training proposed by FC Barcelona is the one suggested by Serres (in Seirul·lo Vargas, 2017) who maintains that it is a competitive simulating situation that we manipulate to facilitate or overstimulate the threshold of accessibility of the player, giving preference to those aspects that are of particular interest at that time. It is for this reason that they are called Preferential Simulating Situations (PSS).

As mentioned, the exercises enter within the variables that make up the optimization of the training. They optimize the operating threshold of training in athletes.

Figure 1: ***Finding flow***



Source: adapted from Csikszentmihalyi, 1997.

The flow of an exercise is the moment when the optimal relationship (optimization) is found between the difficulty of the exercise and the athlete's perception of his or her ability to perform it. The development of PSS based on these premises generates adequate emotional feedback and improves the self-esteem of the athlete.

The design of the PSS must also take into account the difficulty, which will be mastered as the variability (reduction or extension) of the exercises to be performed is modified. They must have a coherent methodological succession.

The design of the PSS for collective sports

Training can be divided into three stages:

- Show: in this case, exercises with a low level of complexity and specificity are introduced.
- Practice: in this case, exercises that integrate real playing conditions are introduced. Issues of space, time, numerical relationships, regulations, etc. must be taken into account here.
- Transform: In this case, the player tries to perfect the elements through variation and exploration.

Table 1: Exercise conditions

Working elements	Learn	Train	Master
Number of repetitions per exercise	High	Medium	Medium
Training time	Minimum	Real	Actual or higher
Disturbing elements	None	Some	All
Disturbing elements	Nowhere	Outside of core	Inside and out
Roles and group	Permanent and stable	Change of role	Constant and conditioned change
Elements to remember	Few	Quite a few	All
Motion elements	Preferential	Automated	Mastered
Spatial elements	Close and internal	Close, remote and global	Strategic
Temporal elements	Internal rhythm	Global Rhythm	Strategic
Demands on efficiency	Medium	High	Maximum
Psychological demand	Low	Medium	High

Source Serres, in Seirul·lo, 2017, p. 210.

Relationship between optimization and creativity

One of the most interesting characteristics of team sports is the capacity that some athletes have to solve certain situations. For the most part, these skills are the result of the athletes' practice of adapting to the environment rather than the instructions of a coach. Creativity is an ability to take into account when optimizing performance, since improvement is not generated by the mastery of a particular technique

but by the invention of new configurations of movement (Vasquez, Balagué and Hristovski, 2011).

Authors such as Hristovski, Davi, Araujo and Pasos (2011) pose two interesting variables that help generate novel and functional motor skills. Noteworthy:

- The first is not to demand too much with the constraints so that the intended objective can be achieved. In other words, avoid limiting the players too much, enabling them to perform actions other than those expected.
- The second refers to suppressing a dimension of the action, that is, leaving aside the standard or established performance parameters. For example, reducing the degrees of freedom in, say, the coordination structure (limiting the number of contacts with the ball by each player) will lead to creative actions, from the point of view of the team system. This constraint used this way would be acceptable, but the same constraint with the intention of optimizing the speed in the control-pass would be limiting, and would be an example of the previous point.

Constraints

Constraints affect the system and lead it to adapt to them; they provoke the emergence of a motor action. If we think of the player system, these constraints can be specific to the player or the context. All of them interact and cause a decrease in the degrees of freedom with respect to what the players would have if they acted freely, and guide players to adapt to them in one way or another. Based on this adaptation to the context (and the context to the player), the player self-organizes to try to be efficient.

For example, in certain spaces of mutual assistance, there are certain channels of communication with teammates that are available, while others are not. The player in possession, constrained by what he wants to do with the ball, but also by his coordinating, conditional, expressive-creative and other structures, will act on the basis of what has been said and will carry out a motor action that will involve a pass to a teammate. Another player, in the same situation, might choose to pass to a different teammate. We cannot say that one action is correct and the other is not; it's imperative that the rest of the teammates jointly organize themselves in a synchronized way to give continuity to either of the two passes mentioned.

It is in learning processes that this capacity for adaptation on the part of the organism can be used most, since different patterns of movement can be provoked by the manipulation of constraints, which allow the system to discover new forms of adaptation in the environment (Balagué Serre and Torrents Martín, 2016).

The constraints on the organism may be of different types:

- Physical: characteristics of the organism.
- Informational: everything that the system is able to perceive.

The speed of a player to overcome an opponent and place him/herself in goal situation is a physical constraint, whereas the ability to perceive the position of the closest opponents to overcome and the lack of teammates with whom to interact, is an informational component.

All these actions interact simultaneously during training, and from their interaction, motor actions emerge. Davids (2001) argues that genes are a variable that influences sports performance, and that constraints interact with that variable and modify the outcome. If an athlete who is genetically apt to be a sprinter is not surrounded by a supportive environment that motivates him/her to endure the training sessions, he/she will not be able to achieve his/her goals. Conversely, in many sports in which height, in general, is critical, motivation will not be enough to succeed.

In training, modification of the environment is one of the variables used so that the system adapts. We must take into account the kind of actions or decisions we intend to train, and how we will constrain players so that, in their adaptation, such actions or decisions appear. The final theoretical objective is a perfect player-context coupling, in which mutual adaptation is constant and optimal.

The player's adaptation arises spontaneously, so it is not necessary for coaches to give instructions. They just have to let the system adapt to what has been presented. Behavior emerges without instruction.

Practice conditions

The definition of our training sessions is determined by the "specific continuous practice, executed with variability and continuity" (Seirul·lo Vargas, 2017). The training session should aim to optimize these game situations through the adaptation of players to these situations, shown in the training sessions with variability.

If we continue with the concept of optimization, from the perspective of FC Barcelona, related to team sports, practice will have the following characteristics:

- Continuous: refers to the type of exercise as opposed to interval training. Continuous training is where resting times are very short or non-existent, so practice is relatively constant. On the other hand, interval training includes periods of practice separated by intervals of rest.

- Specific: the exercises that are presented to the players approximate the reality of the game. In other words, players practice motor actions that come from the game itself, in a context, modified to reduce the complexity of the exercise, that is also similar to the game. The compromise between the specificity of the exercise and the need for certain behaviors to emerge that are intended to be optimized, is one of the points that the coach must take into account when designing the exercises. The use of constraints or appropriate conditions is key. In any case, what is intrinsic to our sport is respected for the specificity of the game:

    - It is a cooperation-opposition sport.
    - It is a sport where there is a moving object (ball), and the possibility of acting on it, or performing actions (movements, displacements) at any time, based on the information that the players receive from the various elements, and their interactions, that belong to the game.
    - It is a sport where there is a space shared with teammates and opponents.
    - It is a sport where there is a space that is polarized by marked zones.

Variability: the player encounters constantly changing contexts, and has to adapt to them. The behavior or motor action that we want to optimize is not rigid nor does it try to follow a pre-established model. Therefore, the player optimizes it based on specific circumstances, which, for the success of the action, he/she must adapt to. If we take into account the specificity of the previous point, this variability does not distance the exercise from the reality of the game: the optimization of the motor action or behavior is more applicable to the game. If variability were such that we moved away from specificity, then it would not have as much application, but it would serve to focus the exercise on increasing creativity and, with it, the players' possibilities of action. Adaptability, the product of variability, is closely linked to creativity.

Variability arises as a proposal for the optimization of sports performance. Traditional strategies of correcting techniques through repetition and feedback from coaches do not generate ideal results in sports learning processes. Such instructions (given by coaches with the intention of seeking the "ideal technique") may hinder the natural coordination of some athletes.

Variability in motor movements expresses the adaptability of the system to adjust, change or select new patterns for change. Coordination patterns are variable and stable at the same time.

Variability generates instability, which is indispensable to move to a new coordination state and thus conquer a new motor pattern. This enables the possibility of obtaining, over time, a great motor adaptability at the disposal of contextual disturbances. Variability summarizes two processes that occur in athletes: adaptability (flexibility) and stability.

- Continuity: the time the players need to optimize what is prioritized in an exercise. We can't expect to do an exercise with certain goals and, at the end of it, get as a result that the players already master that goal. If we pay attention to the variability previously mentioned, which implies a multitude of contexts and elements that interact, and if we understand that the learning of the players is not linear, because they are complex beings; then it is necessary to allow for a period of consolidation of the objective, where several (or the same) exercises are carried out with the same goal of optimization.

Then, when designing exercises, we take these points into account to try to reproduce game situations that we are interested in practicing, in order to optimize them.

Complexity in sports implies a paradigm shift in training. It doesn't make much sense to try to optimize specific motor actions, or even coordination between teammates, if we do not take the situation of the game, i.e. the context, into account. Therefore, our exercise will not be aimed at optimizing the pass, or playing with a third player, but rather resolving certain game situations that, based on our experience, can usually be resolved by playing with a third player, which includes mastering the pass.

We use exercises with more isolated actions if we want the following:

- To present or remember possibilities for action. If a player, due to his sporting maturity, still does not know or use certain technical actions (for example, he/she does not know about oriented control that serves to overcome the rival, or he/she is not used to make a feint prior to receiving a pass), we can take a first approach to this action so that he experiences isolated situations (less complex, with less degrees of freedom) where these actions appear. Once this action is recognized, it becomes a possibility of action that could emerge in more complex situations, that is, in more realistic contexts. Obviously, you will have to practice this action in those contexts for it to actually emerge.

- To optimize decisive actions that rarely happen in a real context. If we believe that we should optimize the bicycle kick in front of

the lateral center, then we are forced to move away from the reality of the game and propose isolated actions, so that (through more explicit learning) they can practice these actions. It is also a presentation of possibilities of action, but this time not because of the player's level of sporting maturity, but because of the fact that this situation appears so infrequently, that they may have never practiced it. It is up to the coach to decide if it is necessary to spend a lot of time on such specific actions.

The game situations to be optimized can be many and diverse, depending on the needs of each team. From the analysis of the team, whether it's a competitive game or in free play, we can detect which game situations we still need more information on to be able to resolve them, or which tend to get resolved in ways that go against our game philosophy.

1.2 Space in training

Reduced spaces

Next, we will discuss the characteristics and benefits of training in confined spaces. The possible advantages and limitations of such proposals will also be provided.

Gabbett (2006), defines small-sided games as "skill-based conditioning" or "game-based training". They are moments in the game where all the characteristics interact at the same time. It is the stage where all the possible events to be found during the development of the game are manifested (Parlebas, 2001).

Small-sided games (SSG) have been widely used in the last several years, especially in development programs for young players. It was noted that playing freely as a child on the streets of one's own neighborhood generated greater motor potential than traditional training. SSG are an adaptation based on what groups of children do on their neighborhood streets.

SSG are defined as collective duels, carried out in a common space and with simultaneous intervention. As their name indicates, they are carried out in a smaller space, with modifications to some rules (to be considered) and with fewer players.

As we've already discussed throughout the program, one of the most important features of this type of approach is that improvements in performance are achieved when training proposals are specific to the sport in question. Players are stimulated by events they face in official games. In SSG situations, all the physical, physiological, psychoemotional, technical and tactical demands of soccer are met.

These proposals are not only specific and effective (Gabbett and Mulvey, 2008) but also greatly motivate the players while they train, making it an important variable for training processes.

Advantages of their application

Familiarity with real game situations, added to the possibility of training according to the game model or idea of each team and constantly having to make decisions, allows training time dedicated to play to be optimized. This is most important in the formative stages where the accumulation of experiences must be more specific.

We will discuss some of the advantages of using small-sided games based on what Casamichana Gómez, San Román Quintana, Calleja González and Castellano Paulis (2015) propose:

- Demands related to the requirements of the game.
- Decision-making training (information and action intimately linked).
- Possibility to train in accordance with the game model or idea.
- Optimization of training time.
- Motivator for players.

Next, and in line with the work proposed by Casamichana Gómez, San Román Quintana, Calleja González and Castellano Paulis (2015), we will discuss the topics mentioned above.

- Demands related to game requirements: at this point, SSG give the advantage of generating specific stimuli where players train and move in the same way as in a real game. Training is not done under the tutelage of the training methods of individual sports, where none of the variables is related to what happens in a game.
- Decision-making training: in SSG training, players are in permanent interaction with changing situations, in which context perception and decision making are permanent actions. The improvement generated by the use of real game situations (2 versus 2, 4 versus 4) has been studied, and it was found that in these situations, not only do decision-making variables and their tactical-strategic component improve, but, more importantly, the technical resources of the player also improve. This shows that traditional training methods based on isolating an ability to improve it in situations of non-specificity do not generate better results than training in a specific way.
- Possibility to train in accordance with the game model or idea: as it is a team sport, the importance of tactics and strategy, and the relationships that are generated between players, should not be neglected. In the application of the SSG, the direction suggested by the coach must be focused. It's not only a matter of proposing a 2 versus 2 situation and letting it play out, but each

coach, within the SSG, must guide the ideas of the game model. The intention should be to structure the exercises aimed at consolidating a pattern of play and for the team's efforts to be in line with this.

- Optimization of training time: the vast majority of players unarguably want to train in game situations. There isn't a single child who doesn't eagerly await the end of class to play. If there is one thing that SSG generate, it is the interest of the players in participating in the mini games. In traditional training, players are not often in contact with the ball, making decisions, or interacting with the team, etc., which generates a lack of motivation.

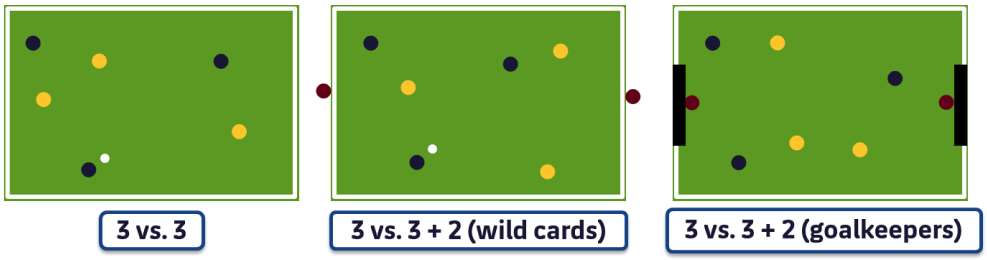
The study by Casamichana Gómez, San Román Quintana, Calleja González and Castellano Paulis (2015) shows disadvantages or limitations to this approach. Here are some of them.

Limitations:

- Need for technology to measure the training load: reference is made to the limitations to knowing the internal (physiological) and external (what the subject does) load on the players. Not all teams have the means and resources to access such measuring devices.
- Minimum number of players to carry out the session: the coach must have the ability to adapt his training program to the number of players present.
- The demanded load is a dependent player: individually there is a lot of variability in players when exposed to SSG, since uncertainty generates different types of responses that are difficult to measure. The opposite happens in traditional methods where the degrees of uncertainty are reduced when dealing with linear and closed approaches.
- The level of technical ability affects the players' demand: SSG must be adapted to the players' level, from the dimensions of the field to the proposed rules, as this determines the time the players have contact with the ball and possession percentage. Technical variables improve as the player uses the intended resources in the game.
- For players with high levels of physical fitness, SSG may not be a good stimulus for the system: in this case no studies are found to prove such a hypothesis. SSGs are interpreted as not generating the physiological stimuli necessary for those players in good physical condition.

The following are some examples of application to be put into practice:

Figure 2:



Source Mallo and Navarro, 2008, p. 208.

In the examples above, the size of the goal, whether it's positioned or not positioned (placement of the goal in different areas of the playing field), the number of players and supports, and the dimensions of the playing field can vary.

The following modules will detail other variants used as methodological approaches for performance optimization in soccer. These proposals have to do with *rondos* and *position games*. These approaches give a more detailed look at the "keys to the philosophy of FC Barcelona's playing style".

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