Module 3. Teaching method for error correction and transference

Unit 3.1 Teaching method III

3.1.1 Introduction to the stabilization phase

To go through this phase of motor learning and technical training is to free the attention of the regulation of the movement itself and be able to attend to and solve other tasks and challenges, which implies a "liberation". This is achieved once, due to the great mastery of the motor skills that has a trained, generates an automatism that allows the motor cortex to stop regulating that action and focus on others, such as decision making.

Two great thinkers contributed their ideas, to which we adhere:

- **Aristotle:** “Excellence is not an act, but a habit.”. Here he likens the concept of excellence to a certain automatism in acting.
- **Saint Thomas of Aquino:** “Virtue is a good operating habit”. It is notable that Saint Tomas also recognized moral excellence as an automatism.

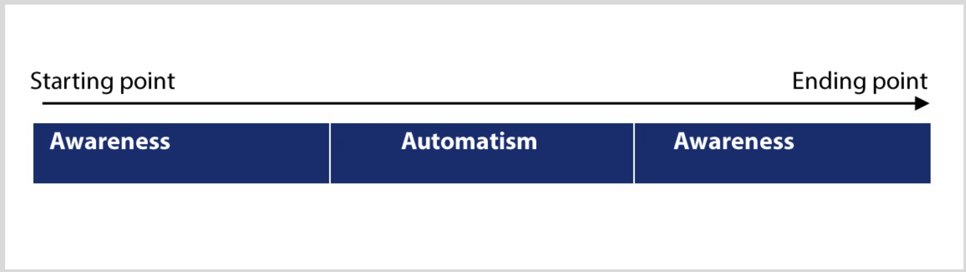
If we take it to a more philosophical plane, in both cases there is no deliberation or options, that is, there is no freedom. However, this lack of freedom in the area of consideration of alternatives is what makes us, precisely, free.

The coincidence is perhaps not neurological; however, it has to do with excellence, as in motor learning. As discussed in previous courses, the act of automating represents the passage of motor actions controlled by the cerebral cortex, to control regulated by the basal ganglia. That the cortex does not regulate the totality of the motor executions does not mean that the movement is unconscious, something usually taken as a truth.

In our view, a movement is not unconscious, but is partially automatic, with the exception of reflexes, in which the beginning of an action is triggered in response to a stimulus. The other movements are born as a product of the conscious will to generate them and then their development occurs automatically until we decide to put an end to them.

We could refer to automatic movements if we compared them to a sandwich, in which the two loaves are conscious processes and the filling is the automatism.

Figure 1: Automatic movements



Source: Prepared by the author.

The act of automating depends on the capacity for creativity that we may have. This can be explained from the fact that if we release the cerebral cortex so that it can be used in decision-making processes, the cortex is in a condition for decision-making and creativity in tactics and strategy. If the regulation of movement itself occupies the subject's concentrated attention, this is not possible.

Having said the above, it should be clarified that we cannot restrict all motor creativity to the process of cortical release through automatism. Creativity in tactics and strategy will depend on, for example:

1) The student's the physical preparation.
2) Perceptual training and their ability to discriminate what is really relevant.
3) Decision training.
4) Their emotional state and their control.
5) Their motor background, also called motor repertoire.
6) Their capacity for concentration and attention.
7) Mental training and the image of the movement.

Just as it is of great importance in terms of tactics and strategy, cortical release is also very relevant in technical executions. This can be explained with the knowledge that there are complex movements in which we must inexorably pay attention to certain phases. Therefore, automating simpler technical aspects allows us to focus on those complex critical phases. Clear examples of the above can be seen in sports training such as gymnastics.

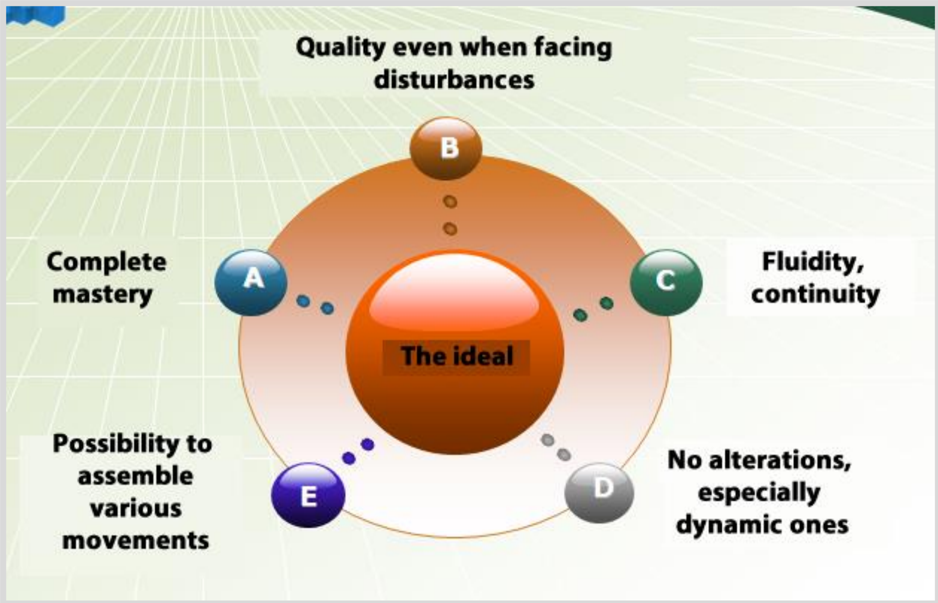
3.1.2 Characteristics of the stabilization phase

Like the previous two phases, the Stabilization and Variable Availability phase has its own characteristics that differentiate it from the other phases. The main characteristics are:

- Ability to perform the task: a high level of safety and quality can be observed, even in adverse conditions. The failures in this phase are not very noticeable and rarely significant. It is possible that our pupil can perform the motor action several times without committing an error, since, through repeated practice, they have mastered the technique, even in adverse conditions.

- Execution quality: complete mastery and high quality can be seen for the motor patterns despite the disturbances.

Figure 2: Quality of execution, optimal execution



Source: Prepared by the author.

- Motor sensations: there is great precision and quality in the verbal description of sensation. In these instances, the student has the ability to detect faults, even before the movement ends. The sensations the performer can perceive are more complete than in previous stages. These are more comprehensive and add another type of sensation to the visual sensations, such as kinesthetics, for example. Although the student may detect technical errors during execution, we recommend that even when errors are detected, execution of a complex skill should never be stopped or suspended.
- Images of the movement: Profiling a correct image of the movement can take years of training. At first it is more diffuse, but with the passage of time it is adjusted and becomes more precise. In this stage there is an anticipated and precise image, which may also be creative and varied. This is the optimum time to polish and exploit it as a methodological resource.
- Direction and regulation: in this stage the student has a high capability to anticipate and stabilize the results and especially to decide the most opportune actions before the rivals.

  Revising what we have studied in previous courses, this is explained as follows:
    - The regulation of movement depends, par excellence, on proprioceptive loops, and its processing depends on the cerebellum and the basal ganglia.

- The exteroceptive analyzers (sight and hearing) are less and less involved and the subject may not depend on them at all for the regulation of movement.
- However, the cerebral cortex does not stop intervening, even in highly automated movements, which is also an advantage.

3.1.3 Objectives of this stage

Broadly speaking, the main objectives and measures in the stabilization and variable readiness phases are as follows:

Table 1: Objectives and measures of the phase

Objectives	Measures
Capacity for self-correction. Progressive stabilization and automation. Adaptation to variable condition and defining technique under extreme stressful conditions.	Focused training of motor perception and observation. Variation of conditions. Increased disturbances. Creation of stress and extreme difficulties. Mental training.

Source: Prepared by the author.

Other objectives of this phase are:

- Develop the capability to self-detect and self-correct errors.
- Achieve a versatile and variable readiness for the technique, whatever the complexity of the context and the circumstances.

The general teaching method for this phase will be determined by the measures hoping to be achieved. The adaptation of the technique to variable conditions through competition itself and other disturbing teaching measures should be encouraged. Adaptability to varied conditions is improved by the execution of the movement and is reinforced by mental rehearsal.

High stability is only achieved if the movements are practiced at competition speed or higher loads. Recall that resistance to fatigue, especially proprioceptive fatigue, is crucial: to develop stability in the technique regardless of tiredness levels.

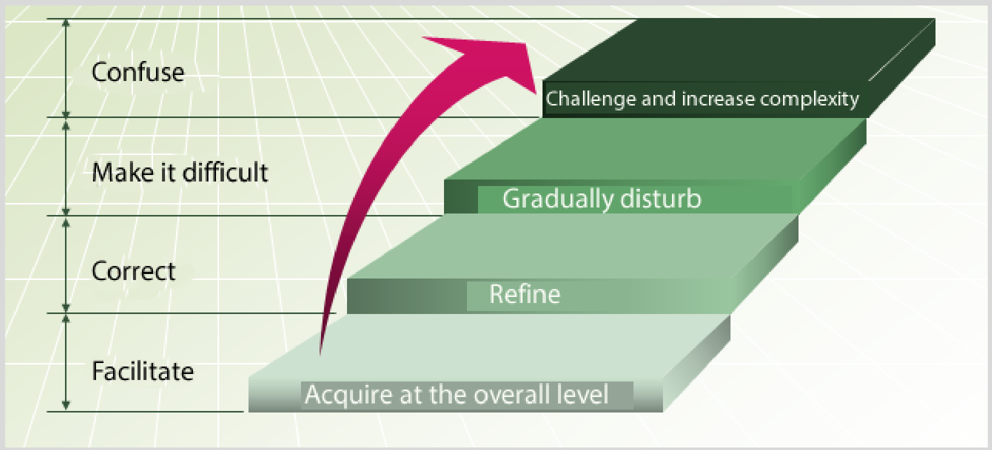
Consecutive practice, without variation, can produce what is known as *stereotype blockage*: this is one of the least desired consequences for any athlete, since it slows down progress and greater accomplishments. This blockage happens when we practice without varying the standardized execution conditions (repeating just for repeating): without involving mental processes or disturbances. Repeating without change can lead to an adaptation of the sensory organs to the same external conditions, which hinders their sensitivity and makes motor programming according to the circumstances more difficult.

Stereotype blockage not only occurs in timed and measured sports. In the latter what is usually produced is the so-called *velocity barrier*, a fearsome manifestation of a stagnation in cyclic sequences, with an inability to change pace.

3.1.4 Special teaching method for the stabilization phase

Similar to the previous progressions, in this phase this process is versatile and depends on the general and special conditions.

Figure 3: Suggested progression in sport



Source: Prepared by the author.

The idea that governs this progression is the generation of sport-oriented motor variability. For this we can complicate motor executions in several ways:

- Varying the dimensions of the playing area and the rest of the external conditions.
- Implementing unstable training.
- Varying the initial position, attempting to change it to positions they are unaccustomed to.
- Varying the velocity of the movement.
- Using unforeseen external forces: from traction or thrust and with different vector components
- Inverting the execution with mirrors: which is a visual processing challenge with greater demand on the parietal areas
- Avoiding the use of an extremity, for example: no arm movement when running or no kicking when swimming, and similar demands
- Restricting perceptual information: either without vision, hearing or even without haptic sensitivity.

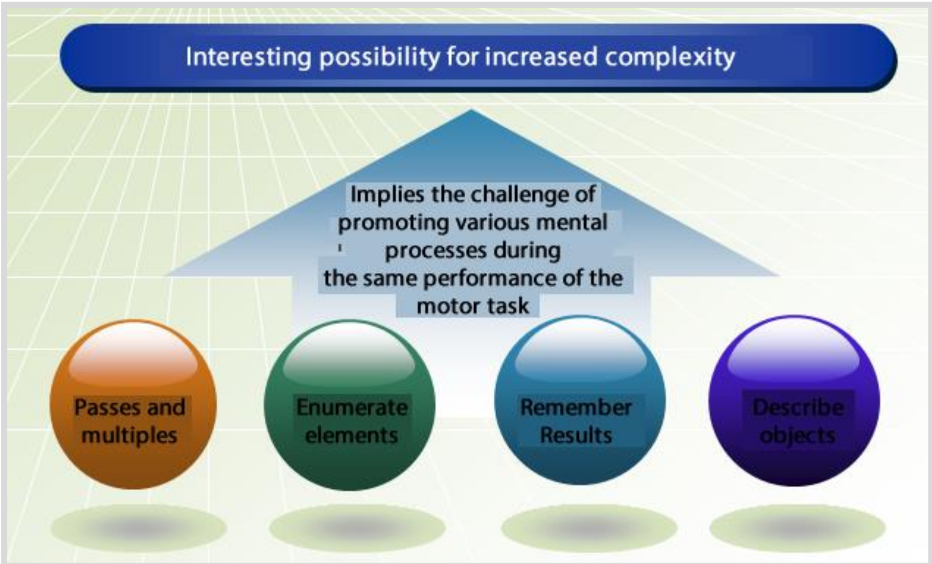
- Working with two equal or different elements.
- Changing the weight and texture of the elements.
- Hindering the background-figure contrast.
- Stopping music and redoing the activity with precision.
- Not using the dominant eye.
- Executed with the non-dominant side of the body, among others.
- The possibilities are innumerable and will be effective as long as we are creative and generate proposals that adapt to the subject and their problems.

All of the strategies mentioned above as well as others that we develop, can be made difficult by the use of two important resources:

- Unexpected sensory distractions: not only auditory, but also visual, tactile and of any other sensory nature.
- Increase application of force: with additional overloads, uphill slopes, and complementary devices

Performing two or more tasks at the same time is another useful resource. What we call multitasking, which can be defined as concurrent tasks of varied and increasing complexity, not limited to the motor, but also to mental resolution challenges.

Figure 4: Mental tasks motor execution

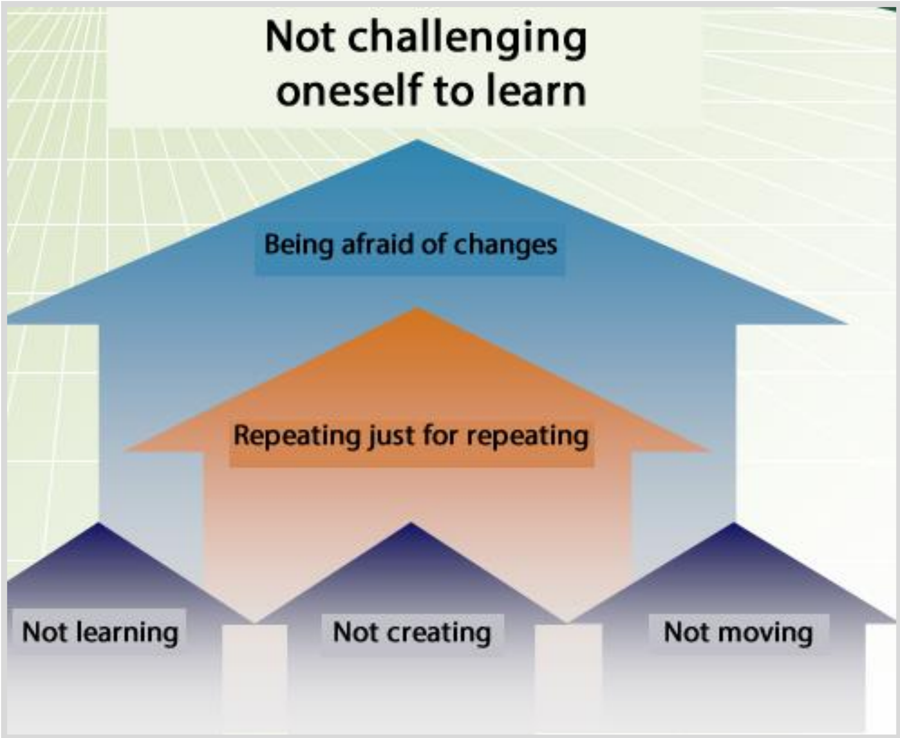


Source: Prepared by the author.

Although the foregoing is linked to the sports field, the same can be applied to everyday life, not just on a whim, but rather for the benefits that this would bring. It would be an interesting resource for delaying nervous system degeneration.

It is important for non-athletes to always try to learn new things, or to do things they already know, but in a different way. All this proposal of variability is based on chaos theory, if we understand that everything, however stable, can collapse. The main idea is to prepare yourself to be prepared; train to anticipate disorder. What is fearful in any learning process is not to pose challenges, which will lead to stagnation, a performance ceiling.

Figure 5: Risk of no variety



Source: Prepared by the author.

Unit 3.2 Teaching method IV

3.2.1 Transference and interference in motor learning

The development of motor capabilities is widely executed. Most of the time you learn several movements at once, often, many uncontrolled movements, as a product of unsystematic learning, based only on practice. This can be observed especially in children's play. To better understand the relationships existing in the refinement of various motor actions, it is necessary to go deeper into the laws of the motor learning process. Among them is the problem of transference (Meinel, y Schnabel, 2004).

Many motor skills learned by human beings are interrelated. In addition, the skills acquired are not limited to the specific situations in which they were learned, but can be transferred to other situations. This transfer takes place both within the same area of human activity (sports motor function, work motor function, daily life), as well as from one area to another (Meinel and Schnabel, 2004).

The motor learning process starts from scratch. There are always certain "coordinating samples" as a basis, which can have either a positive or negative effect on learning the proposed motor actions. According to the type of influence exerted, interference or transfer may occur (negative or positive transfer, respectively) within the motor learning process (Meinel and Schnabel, 2004).

Interference can be expressed in sports in several ways: as old coordinating combinations that block new combinations, or as new coordinating combinations that negatively influence one another (Meinel and Schnabel, 2004).

The effects of interference are observed not only when altering a technique which is similar to others, but also when we learn movements whose coordinating structures oppose each other, as happens, for example, when changing from one sport to another. Interference disturbances also arise frequently when several simultaneous movements are learned which have very similar structures. In this case a learning law is effective according to the following: the more two movements are learned successively, the worse the retention effect for these movements is. The phenomena of interference disappear almost completely by increasing the differentiation of movement programs, both on the basis of conscious improvement in sensory and verbal processing of information and through more precise contents of motor memory (Meinel and Schnabel, 2004).

Another important process is *transference*. This is the process of a positive effect of transmitting one motor action to another. The necessary condition for this transfer to occur is that there are coordinating coincidences between the respective movements. Berstein (as quoted in Meinel and Schnabel, 2004) pointed out that what is important for transference is a coincidence in the sensory motor coordination mechanisms and not the external similarities in the development of the movement, which is especially evident in motor skills with high demands on the regulation of balance.

In the case of transference, two forms can be distinguished: a transfer on the basis of previously learned motor actions, and another transfer in the learning of simultaneous improvement of different motor actions.

In order to effectively use the positive effect of transmission, both in successive learning and in the development and simultaneous refinement of motor skills, it is necessary to discover the structural kinship between the movements of a particular sport and of different sports. This is especially true of those sports in which many actions are to be learned individually. The discovery of structural kinship plays an important role not only within the same sport, but also among the movements of different sports (Meinel, and Schnabel, 2004).

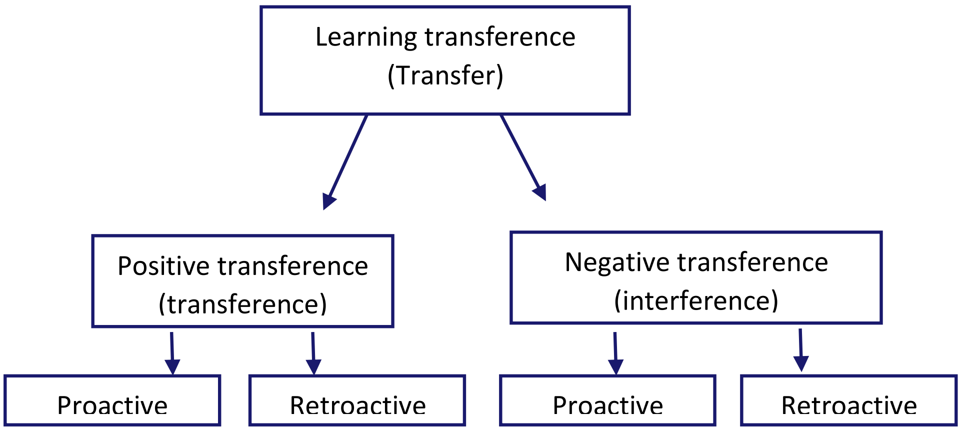
A special case of transference is the problem of laterality or cross-transmission. Exercising a movement on one side of the body produces a positive transfer effect on the other side of the body due to the functional relationships between the two cerebral hemispheres. The motor idea also plays a very important role in the formation of the ability to execute a movement on the other side of the body without having previously exercised it (Meinel and Schnabel 2004).

Research results obtained by Drenkow (as cited in Meinel and Schnabel, 2004) showed that practicing throws with only the right arm also caused an improvement in the other arm. In addition, it was verified that when exercising both arms, higher throwing performance was achieved as compared to when only exercising a single arm. According to Soviet research (as cited in Meinel and Schnabel, 2004), the motor accuracy of both arms is approximately equal up until 7 years of age, and then the accuracy of right-side movements begins to increase. At beginner level there is rarely a better or worse side. That is why it can be said that the formation of the "good" side is conditioned by the activity, that is to say, that it is the result of a prolonged exercise of the movement on one side of the body. In sports where a functional dominance of one side of the body predominates, but where a bilateral execution capability is recommended for tactical reasons (sports games, combat sports, etc.), it is important to take into account the principle of bilaterality (Meinel and Schnabel, 2004).

3.2.2 Transference in technique training

The learning of sports techniques requires the formation of coordinating structures that are based on the "linkage of numerous centers of distribution and coordination in the central nervous system" (Grosser and Neumaier, 1990, p.149). Through multiple functional bonds in the central nervous system (CNS), the entire motor domain is linked to a complete system (Grosser, and Neumaier, 1990).

Figure 6: Learning transference



Source: Grosser and Neumaier, 1990, p. 249.

As each movement was learned in the most differentiated situation possible and in very varied tasks (which look alike or are completely opposite), we create coordinating links that, depending on the circumstances, may have an activating or inhibiting effect for learning new movements.

According to the type of influence of the techniques learned for new learning, this is referred to as positive or negative transference (*transfer*). Here we are dealing with the so-called proactive transfer influences. If, on the other hand, there is an influence of new learning towards previous learning processes (positive or negative), these transfer influences are called retroactive influences
A negative transfer (interference) can be manifested in sports practice in different ways:

- Existing motor patterns disrupt the formation of new coordinating processes and delay successful learning. This is often observed when one has to modify a learning (modification of the technique, elimination of fixed errors). Before the formation of the new elements of the motor program, the old ones have to be eliminated. Otherwise, there may be a relapse to the original movement in the event of high loads.
- There are also learning disturbances, often when several movements whose structures are very similar or totally opposite need to be learned at the same time.

Negative transfers lose their effect considerably with the improved refinement of the motor program. For sports practice, the following basic rules can be followed to help prevent a negative transfer:

- In order to avoid modifying motor learning, it will be necessary to always target the technique considered to be greater, according to the level of the investigations.
- The newly learned movement must reach a certain degree of security before the athlete begins practicing another similar or very opposite movement.
- Disturbances in learning as a consequence of a negative transfer can be diminished by encouraging in the pupil the compression and conscious comparison of the details and structures of the movement (Grosser and Neumaier, 1990).

Preconditions for a positive transfer are the common coordinations in the corresponding movements. For this, they are decisive, not the external similarities in the unfolding of the movement, but "the equality of the sensorimotor mechanisms of its coordination". It is therefore important to discover affinities of movements to take advantage of positive transfers as well as to find the most appropriate order of the movements that must be learned, as well as to incorporate different sports-motor skills at the same time.

A specific example of positive transfer is the transfer of the effect of practice from one side to the other (co-exercise, bilateral transfer). It is known that the exercises practiced intensively on the right side can also be performed by the left side, although with less precision. This transfer is produced by the functional interrelationships between the two hemispheres (Grosser and Neumaier, 1990, p.151).

Table 2: Types of Transfer

Type of transfer	Examples
Positive: • Proactive • Retroactive	Transfer of the learning effect within a series of exercises, from exercises to exercises. Learning different swim techniques (the push from leg to back comes out better after learning the crawl).
Negative: • Proactive • Retroactive	Simultaneous learning of: • Race with small jumps of one and another leg and race with alternative jumps of both legs. • Jump shot in handball and shot in volleyball. The gymnast learns to swim (through muscle contraction). After learning handball dribbling, there are more frequent footfall failures in basketball (two-step rule) after learning table tennis, a tennis (racket) player strikes suddenly by turning the wrist.

Source: Grosser and Neumaier, 1990, p. 151.

On the other hand, positive transfer can also occur by practicing with the "weak" side. In addition to the tactical advantages in sports games and fighting sports between two participants, this practice favors the balanced development of the whole body.

In short, it can be seen that the recognition and use of the phenomenon of positive transfer can develop the learning process more effectively and shorten it.

In planning technical training, the following points should be taken into account regarding the effects of transfer:

- Motor learning always has to start from simple and basic skills of a structure and move from there to more complicated ones.
- During the development of the physical condition, those movements that allow a positive transfer to the movements belonging to the current learning process should be applied.
- Numerous previous exercises delay learning. That is why it is important to do only a few exercises beforehand, but those that favor transfer.
- Once a certain level of mastery has been achieved, exercise with both sides has several advantages (Grosser & Neumaier, 1990).

3.2.3 Stabilization and variable readiness: multitasking

Multi-tasking is not a long-standing concept: in recent years we have begun to hear about the methodological possibility, the application of which corresponds almost exclusively to the final phase of technical training. Based on complexity and the theory of dynamic systems, it allows for great methodological possibilities. Ideas that underlie the proposal.

It is important not to confuse this concept with that of segmental dissociation, which assumes that we can perform different motor tasks with various segments, but always from the motor point of view. On the other hand, multitasking is not limited to motor tasks, but can incorporate another type of task of a specifically mental character, such as enunciating, observing, and much more. There are also common features between the two concepts:

- Activities executed at the same time.
- Two or more motor tasks.
- Perceptual tasks, enunciation tasks and so on, not only motor tasks, which implies enhancing motor control.

We aim to highlight conceptual differences so as not to create confusion. Here we are talking about complexity and not risk; they are not synonymous. This complexity is sought from the simultaneous application of motor or mental tasks, which aims to enhance psycho-neuro-motor functions. In this way the process of attention and concentration is almost at maximum, in order to guarantee motor control in different and simultaneous tasks. This does not necessarily imply increasing risk levels and placing the subject in situations in which the likelihood of injury increases exponentially. We propose the following progression for the use of this tool:

1) Separately: master each task separately.
2) Successively: then try in succession, with few attempts.
3) Simultaneously: then try at the same time.

We have 2 broad task groups and then an initial listing of combination possibilities:

a) Motor tasks.
b) Mental tasks.

Possibilities for combination. Start list:

- Technical motor patterns.
- Postural tasks.
- Perceptual tasks.
- Enunciation tasks.
- Mathematical tasks.
- Motor capabilities.

From the anatomical point of view, simultaneous tasks can be experienced from the areas of the body involved:

- between sides of the body;
- between the upper and lower body;
- between the upper and lower and sides of the body.

There are three levels of difficulty:

- Motor tasks with each other: when we combine only motor tasks with each other, not only two but even more, whether related to technical gestures, motor skills or postural tasks.
- Motor and mental tasks: when we combine a motor task with a mental task, which often proves to be much more complex than previous options (despite only involving one of each).
- More than one (both): when we combine motor tasks with each other, sometimes more than two tasks, with more than one mental task involved, which involves complex resolution processes.

Figure 8: Global scheme of difficulty

Source: Prepared by the author.

The motor tasks can be divided into three large groups:

a. Motor capabilities.
b. Technical motor patterns.
c. Postural tasks.

Of these three broad groups, there are six sub-groups representing the possible combinations:

1. Motor capabilities with motor capabilities.
2. Motor capabilities with technical motor patterns.
3. Motor capabilities with postural motor patterns.
4. Technical motor patterns with technical motor patterns.
5. Technical motor patterns with postural tasks.
6. Postural tasks with postural tasks.

As an example, we will explain how motor skills can be combined: when we combine motor skills with each other, six clear possibilities for a methodological approach arise. Even the same motor abilities per side or upper/lower half of the body can take on great complexity, although the greatest benefit occurs when we combine motor capabilities:

1. Strength with flexibility.
2. Strength with balance.
3. Strength with coordination.
4. Flexibility with balance.

5. Flexibility with coordination.
6. Balance with coordination.

We can divide the technical motor patterns into:

- Transfers.
- *Dribbling.*
- Throws.
- Element control.
- Passes.
- Shots.
- Others specific to each sport.

Among these combinations we find:

- Transfer with pass.
- Transfer with element control.
- Transfer with other specifics.
- Passes with element control.
- Passes with other specifics.
- Element control with other specifics.

This creates combinations that can be clearly developed with multitasking. More can be added; however, we opted for a practical and utilitarian simplification.

Postural tasks:

- Lumbo-pelvic.
- Scapular-humeral and cervical.
- Coxofemoral.
- Tri-astragalins.

Mental tasks are divided into three:

1) Perceptual: not restricted to the visual system only. For example, activities that include the proprioceptive system can be taken into account. Within the perceptual, we find:

- Vision.
- Hearing.
- haptics.

2) Mathematics: more demanding from the use of mental functions.

- Additions.
- Subtractions.
- Divisions.
- Multiplications.

3) Enunciation: trying to remember and utter several linguistic structures.

- Elements of sub-sets.
- Self-help phrases.
- Booklet paragraphs.
- Full songs.
- Poems and quotes.

3.2.4 Perspectives and discussions

In our view, when designing plans for a group of students, whether school or sports students, we must take into account motor variability in the didactic proposal. We consider it fundamental that our trainees are not repeaters of motor gestures in which they do not need to involve the cerebral regions related to decision-making, but that they are participants in their own learning.

In many cases, it is much simpler in our circumstances to pose closed activities where the student performs a certain action and this is repeated until a certain result is achieved. Certain questions emerge from these situations:

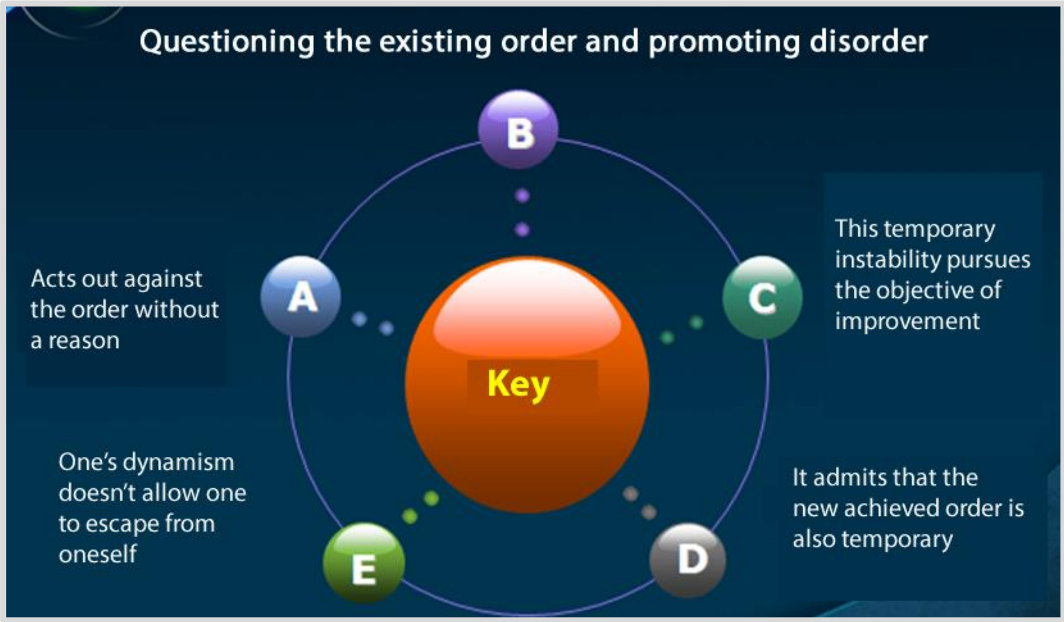
- Is working technique in closed activities bad?
- When our student faces a real-life sports situation, should he/she always respond in the same way?
- Is it possible to address all situations that our student might face?

In response to these questions we can say that technical work is not bad; indeed it is indispensable for the progress of any athlete. But this work has to have a time, a progression, and it should not be the only thing that is focused on. Tactical and strategic thinking – often left out – is crucial to achieving goals in all sports activities. In direct-opposition sports, the actions that our opponent makes will condition our own. Therefore, if the learning process only offers a few problem solving options, our performance will be adversely affected. Obviously, it is impossible to address the totality of ways in which a rival can make it difficult for us to achieve our goal, but if we can work on various possibilities, we will have more tools when we get on the field.

Based on the above, and what we have looked at over the duration of this course, we can conclude that we adhere to the theory of dynamic systems as an axis that can govern our plans. We believe this because it is crucial to understand motor systems as dynamic systems, subject to the principle of variability. From this we should not infer, however, that we cannot apply technical learning sessions.

The variability in the systems of movement is omnipresent and inevitable as a function of the limitations that outline each individual behavior. Variations of movement between individuals and performances are considered attempts to exploit the variability that is inherent in and between different biological systems. Variability in movement systems helps individuals adapt to the boundaries (personal, task, or environment) and then expand them.

Figure 9: Key aspects of dynamic systems



Source: Prepared by the author.

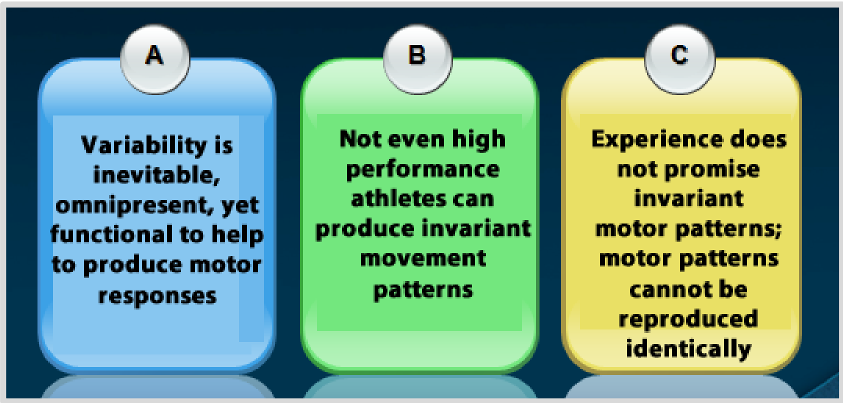
The variability of dynamic systems is an object of study in itself. The classical conception considers variation as a disruption or random fluctuation. From our perspective, psychomotor variability can be conceived as functional. The idea of it being functional derives from the sensory-motor equivalence that emerges from the high degree of freedom of the motor system.

The aim of working from the perspective of variable systems is to select solutions for coordinating structures that emerge under constraints when less functional organizational states in the motor system are explored and abandoned.

In motor behavioral responses, biological systems are required to generate two states in response to changes in the environment and intentions: stable and persistent or flexible and variable. The objective is to induce anatomical and biological changes in the face of old age, injuries, illnesses or painful situations, that help individuals to adapt to ever changing constraints imposed by the environment.

It is of great importance that our athlete does not become too stable in a complex environment of constant modifications, to allow the subject to find functional movement solutions, as much in exploratory behavior as in sports performance and rehabilitation.

Figure 10: Variability



Source: Prepared by the author.

In dynamic systems, the formation of spontaneous patterns between component parts emerges from a process of self-organization. Open systems are open because they are linked in constant energy transactions with the environment. The organization manifests itself as transitions between different organizational states and emerges from internal and external factors that press the system towards changes. So it becomes clear to understand the notion of *disturbance*. Disturbances are obstacles and boundaries that act to delineate the shape of a biological system in search of optimal states of organization, which attempt to reduce the number of configurations available for a dynamic system by organizing the space of all its possibilities.

It is our responsibility to know how to provide appropriate disruption to our trainees so that they do not stagnate in a poorly variable environment and, on the other hand, their learning process is not interrupted because they are over-stressed by the constant variation in stages in which they are not ready.

References

Grosser, M., y Neumaier, A. (1990). *Técnicas de entrenamiento: teoría y práctica de los deportes*. Barcelona: Martínez Roca S.A.

Meinel, K., y Schnabel, G. (2004). *Teoría del entrenamiento*. Barcelona: Stadium.