SETTORE TECNICO

CORSO PER ALLENATORE PROFESSIONISTA DI 1°CATEGORIA - UEFA PRO

“Learning to ‘play in the future’: cognitive and motor issues in football training”

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SUMMARY

1 Introduction

Passing the ball between teammates is one of the basic principles of game in football. The exchange of passes with the ball is easy when players are static but this action becomes significantly harder during the course of play, because game progression is inherently dynamic.

'Missed passes' occurring during football games are usually judged as technical errors. Passes can be too short or too long because of a bad weight of pass, e.g. a bad passing power/direction ratio. In such situations, the receiver must change his run by adjusting the running speed (accelerate or decelerate) or direction. The rhythm of the collective action is therefore not respected, hence affecting game fluidity.

In fact, whether bad passes are made because of technical factors remains an open question in most cases I have experienced.

My interaction with professional players on this issue pushed me to raise the hypothesis that missed passes were not of 'technical' origin. As a matter of fact, asking a professional player to reproduce such missed passes towards a particular location during a typical training exercise resulted in very accurate passes, within 1 or 2 meters. Remarkably, these players often acknowledge that such passes appear more difficult during a match situation but fail to explain clearly why this is the case.

Missed passes represent therefore a complex problem involving game reading, understanding/perceiving the collective action dynamics and the execution of a relevant technical-tactical response. In football, the player is required to transform (game configuration) information into (game) actions (passes, shots, runs). This transformation is linked to the cognitive dimension and has been coined the 'cognitive-motor performance' (CMP) [1]. The CMP has been defined as the ability 'to quickly gather game-relevant information and use this information to adequately execute a certain motor task'.

We are therefore dealing with an issue that is at the core of the cognitive dimension.

[1] Hicheur, H., Chauvin, A., Chassot, S., Cheneviere, X., Taube, W., Effects of age on the soccer-specific cognitive-motor performance of elite young soccer players: Comparison between objective measurements and coaches' evaluation., PLoS ONE, 12(9): e0185460, 1-20 (2017)

Over the last two decades, the cognitive issue became increasingly important to football training and research.

In the specific case of missing passes, I believe that more emphasis should be put on the quality of information gathering and anticipation issues. I propose to call this **'playing in the future'**, a terminology that I will use in the following sections. A correct pass would therefore have to be executed with a good timing, e.g. anticipating the future position of a running teammate.

Analyzing a football match with a different perspective, one can observe that many passes in the game are not well coordinated between the passer or receiver and that there is important opportunity for development of this skill even at the highest levels of football practice.

During the fourth teaching module of the UEFA pro 2022-2023 at the Italian Federation of Football (GIFC), Marcelo Bielsa stressed the importance of this issue. According to him, the search for a perfect timing between passes of players with the ball and runs of teammates is the key-factor for team successes. This strengthened my desire to go deeper into this issue.

In addition, training programs in this area appear to be really poor. The development of cognitive aspects is often restricted to training of reaction times (following a visual or auditory stimulus), and plenty of such systems are now available on the market. I will later deal with the different training possibilities that can be implemented.

In this thesis, I will first try to explain the causes determining the complexity of such passes and will propose some routes that could be helpful for positive evolutions in this domain.

2 Definition

Football is a team (collective) game with ball exchanges between partners of a team.

The pass can therefore be considered as the basic unit of the game: it serves the game !

A quasi-infinite combination/variety of passes exists. A pass can be performed at different directions (360 degrees around the player), heights (from 0 to several meters), and distances and with different powers (sometimes referred to as weight of pass or trajectories (linear, parabolic…).

Passes can be used to keep a certain balance (stability) or to create imbalances in the game. Balance can correspond to ball possession phases in a more horizontally-structured style of play. Thanks to ball controlled possession, a team can prepare offensive action, fix the game rhythm and/or attract the opponent players into a particular zone of the pitch in order to get an advantage (e.g. numerical superiority).

The creation of imbalances is more likely to be related to 'vertical play' or game changes that can be observed in rapid defense-to-attack transition phases. Game imbalances can also be created by sudden attacking runs located in a distant zone of the pitch following a possession phase. Such passes generally allow eliminating opponents (and breaking lines of midfielder/defenders) and put the team with the ball in critical zones for finishing their actions.

The pass is more likely a '2-player' action but it can also be a '3-player' action when the final pass location is reached through an intermediate touch of the third player allowing the ball to reach the desired final zone. The pass is therefore a technical-tactical skill consisting in a coordinated ball transmission across teammates: the level of this coordination is critical to its success.

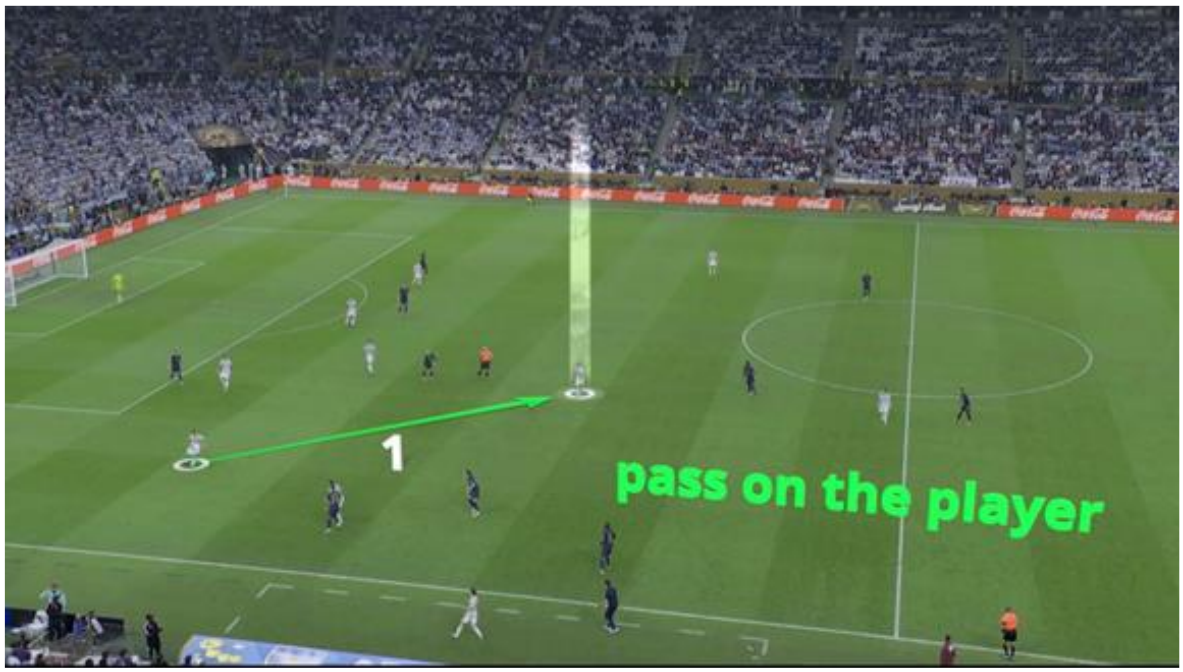
Importantly, I will use the term 'passer' to identify the player with the ball and the 'receiver' his teammate towards which the ball is played.

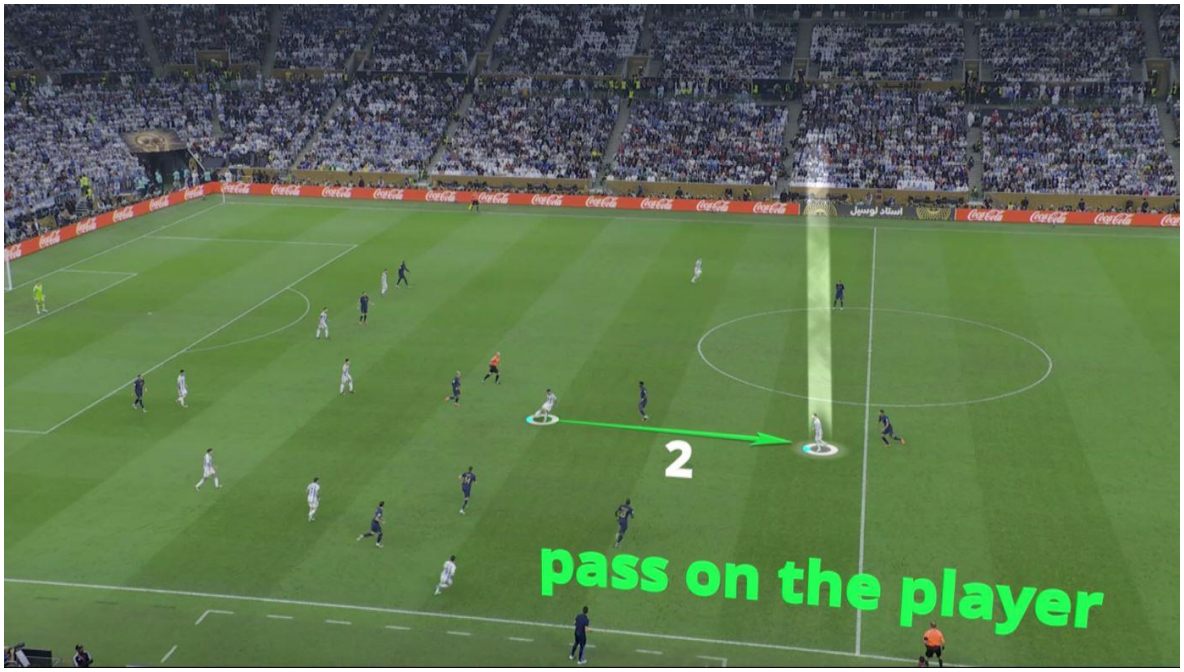
A pass can be played "to the feet" of the receiver or towards an empty zone that will be « attacked » by the receiver (what I call "**playing in the future**").

These two styles of passes can be simultaneously performed during possession or imbalances in the play. The second goal score by Argentina during the last WC in Qatar (2022) perfectly illustrates that.

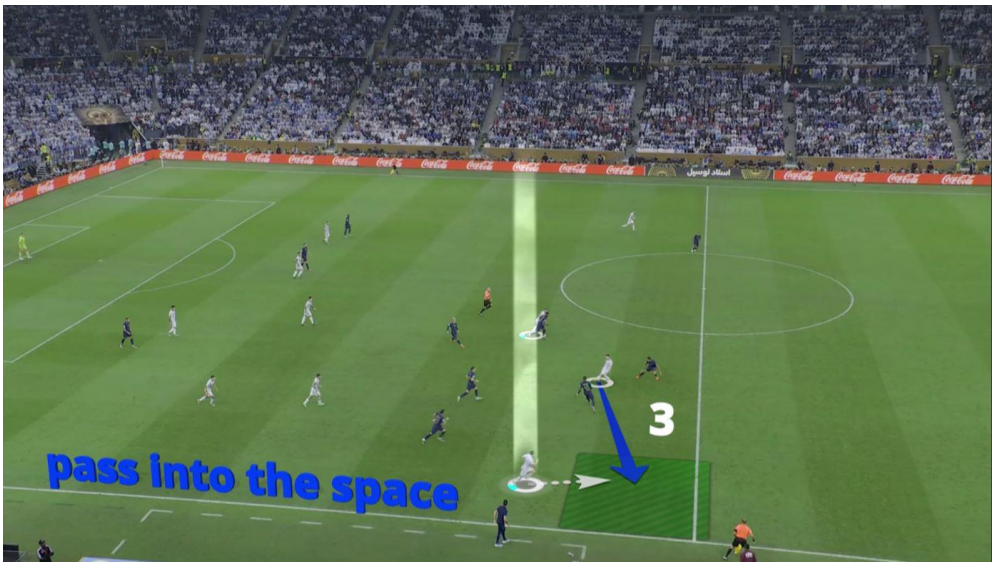
Sequence of passes: 2-0 (Argentina - France) Qatar WV Final 2022

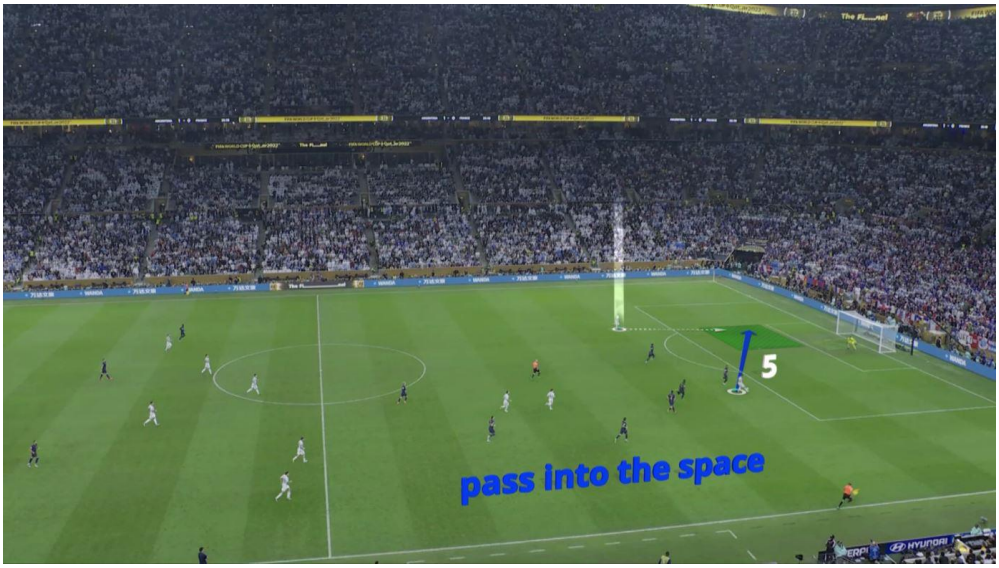
Passes « in the feet » / « on the player » :





Passes « in the future » :





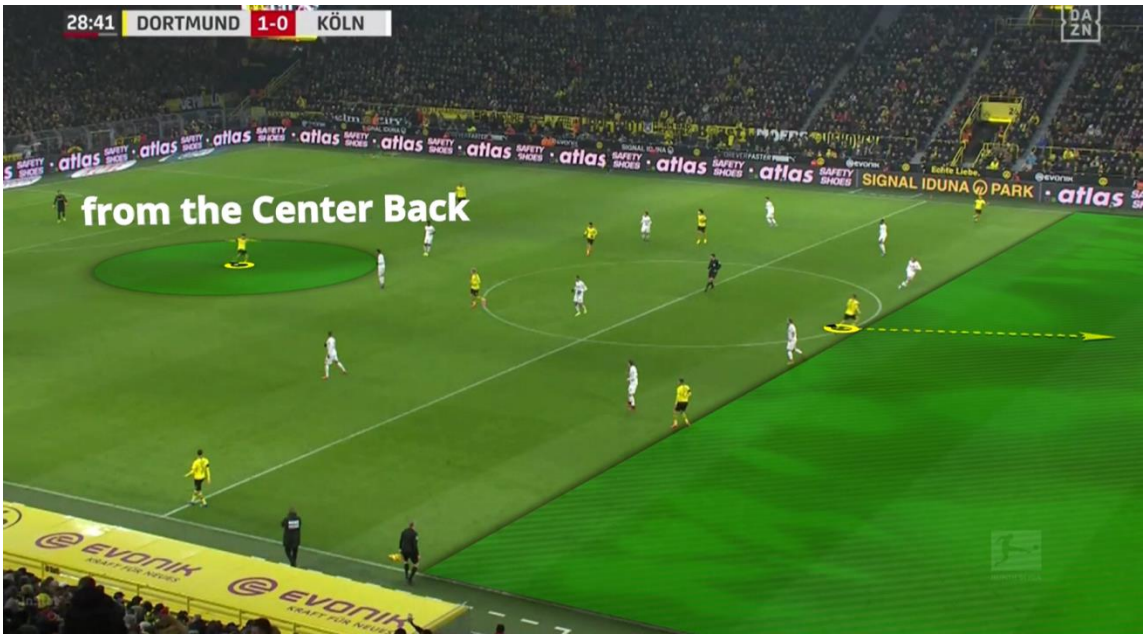
It is equally important to mention the « language » of the pass. Thanks to the pass, the passer communicates important information to the receiver, e.g. a non-verbal language that can be particularly relevant in the case of high level gesture/task execution. Indeed, the power and the direction of the pass can provide cues (or “invitations”) for the next sequence of an offensive action: for example, a player can pass the ball to the right side of his teammate’s run because he detected that the opponent player anticipated on the other side. It should be noticed that this type of communication is more frequent at high level of practices.
It is therefore necessary to explain and work on this aspect very early in the training of young football players in order to get them familiarized with the “sense of their actions” (‘why should I choose a particular action’). Being aware of the potential impact/importance of a pass will likely facilitate improvements of the next pass executions.

In this thesis, I will define different types of passes and describe their characteristics, their potential influence on the play and the errors that can be observed during their execution. I will focus on the passes players in (empty) spaces and their complexity. What I propose to coin “play in the future” is not natural in our sport. I do believe that our training is mostly oriented to “playing in the feet” of our teammates.
A good execution of passes in empty spaces requires a high level of cognitive and motor performance: this should be trained in a systematic way in order to improve this skill. The more often a player experiences such situations, the better he will be in future executions.
Feedback is also of great importance during any learning process, I will address this issue later.

3 A comparison with American football

American football and football (soccer) are team sports where ball transmission is at the core of the play. Playing in the future is therefore present in both sports. While passes “in the future” are systematically trained in American football (e.g. in order to find perfect timings), it is not in soccer. Before developing this aspect for soccer, let us describe the case of American football.

Fictional scenario: let us put a « quarterback » (american football) in the position of a central defender as illustrated below:



What would the quarterback say? : I assume that he will respond that he never encounters such situations where no pressure would be put on him and he could hence pass the ball to his running teammate who would also be free from defenders’ pressure. In few words: something difficult to imagine in American football.

Thanks to an American friend, I have interviewed an American professional quarterback: Andrew Austen Luck (34 years old at the time of the interview in 2023), former NFL player at Indianapolis Colts. I have first shown him video footages of situations comparable to the ones described above, e.g. soccer situations where players can pass the ball without pressure to teammates in empty zones of the pitch, which seem unlikely to occur in American football.

It should be noticed that Andrew (because of his German familial roots and the few years he spent in Germany during his childhood) is familiar with soccer and has therefore immediately identified the teams appearing in the footage as well as the player with the ball: this made our exchanges easier.
Despite being familiar with watching soccer matches, Andrew acknowledged that he never noticed the specific situations that I was showing to him. Importantly, the video footages that I chose were extracted from “tactical footages” with large fields of view that are usually not available for TV viewers like him. In particular, the opportunities to attack empty zones in the back of the defenders’ lines are rarely displayed on classical TV images: viewers can follow the lines of defenders in possession of the ball but they can rarely see the lines of defenders of the opponent team at the same time.

When I asked Andrew to compare such situations with his own sport, he confirmed that this seems unbelievable not to get advantages of such situations in soccer and even proposed a potential explanation for that. He first explained me the dynamics of actions in American football: the existence of many break times between actions offers more time for teams to organize their attacks / defenses. According to him, this represents a specific factor when dealing with game strategy in American football. Such break times are used by teams to reorganize/choose their future ‘plays’ or pre-determined routines. Consequently, every aspect of the game in American football is carefully examined hence offering fewer opportunities for improvisation / creative solutions.
In contrast, the rhythm of soccer games is not compatible with such approach, particularly at a moment where football institutions want to avoid “dead times” during the play.

According to him, it is therefore normal to observe less pre-structured schemes and more improvisation in soccer (where situations are rarely similar) compared to American football where actions are planned in advance and on time to the second / distance to the meter. In fact, perfectly-timed passes in far and empty spaces observable in American football are the result of huge amounts of training time specifically dedicated to training this aspect.
As a result of this systematic training of the passes / runs’ timing, the running player knows exactly the sequence of runs (direction changes) he must execute and the quarterback knows exactly when and where the ball shall reach the pre-determined zone.

In the end, what I initially considered to be extraordinary skills of reading/perceiving running trajectories and passing execution turned out to be (in my mind) a careful planning of coordinated movements. The idea of beautiful “passes in the future” exists in American football but planning and preparation are favored over creativity / improvisation. Andrew told me that improvisation occurs in his sport when the quarterback cannot execute the chosen scheme of play: in this case he must perform a move and find another solution.

This discussion changed my (mis)perception of exceptional cognitive abilities related to game dynamics’ reading/processing in American football, far beyond what I could imagine when watching American football on TV. Further discussing with him, he told me that it would not be possible to play without pre-planned game schemes implemented during training sessions. This sport is so well-prepared and rapidly-executed that nearly no point could be scored without such schemes. The pressure on the quarterback with the ball would not give him sufficient time to read the game situation and implement improvised solutions. As a matter of fact, I learnt that the staff of the NFL teams is often constituted of more than 20 coaches: a specific coach is dedicated to train each offensive or defensive position. One could therefore consider training in American football as high-accuracy surgery. In addition, Andrew told me that training of passes is first performed analytically without opponents and is performed in real match situations thereafter. This represents a large amount of the quaterback’s training.

My current understanding is that because of these differences between American football and soccer, it is not relevant to perform systematic comparisons. Nevertheless, I believe that we could be inspired by the importance given to the systematic training of passes’ timing in American football.

In modern soccer, one can often observe situations comparable to the one described in the picture above: a player with the ball and no pressure and a defensive line in a “high” position on the pitch, with their backs oriented towards their own goals. Such situations where defenders’ backs are oriented towards their own goals while strikers are facing the opposing defenders’ goals can be particularly dangerous for defenders in the case of a good timing between a player with the ball (without sufficient pressure) and the striker.
If the two players coordinate their actions correctly, there is nearly no way to defend effectively if the defenders’ configuration behaves in the way shown in the picture above.

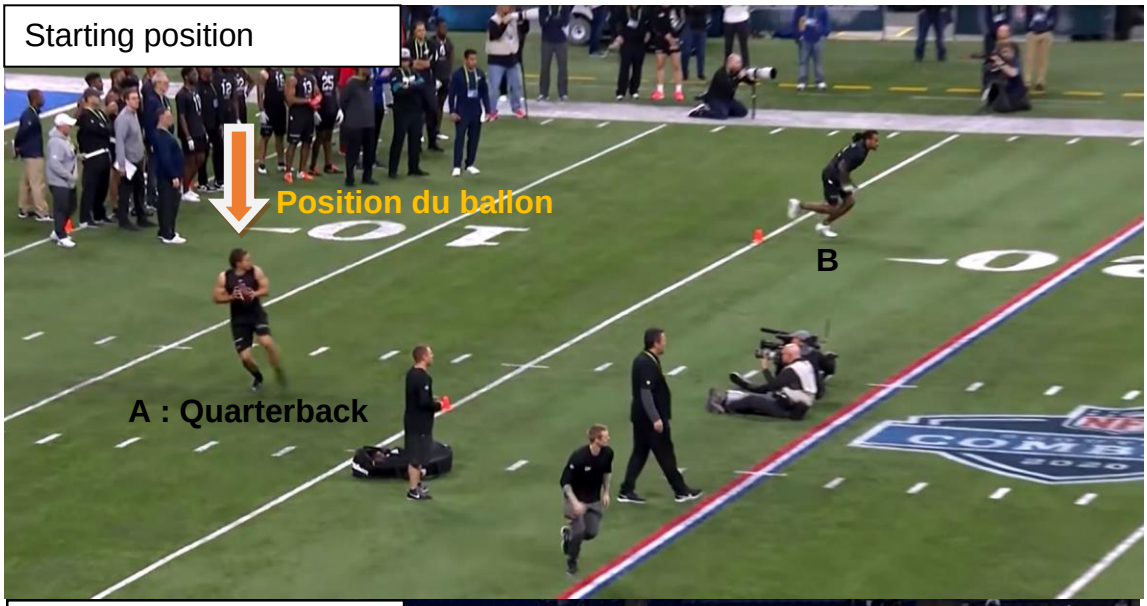
Typically, strikers are in general faster than central defenders, offering further advantage to the forwards.

I believe that we could be more efficient in such game situations if our abilities to play accurate passes « in the future » improve. In current professional soccer, a lot of potentially dangerous situations (that we could take advantage of) are not systematically trained. Such situations are not played because of the lack of offensive risks / initiatives rather than because of great defensive performances.

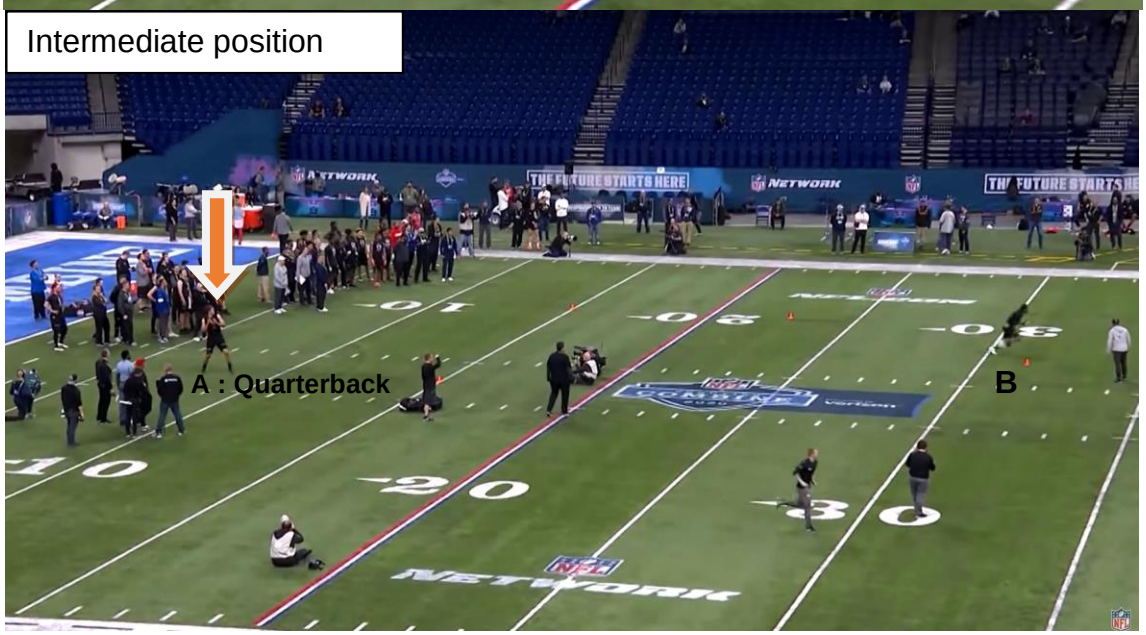
In American football, the systematic search/training of the perfect timing is a priority. This should also be the case in modern soccer. I have emphasized earlier in this thesis the critical role of passes as fundamental unit of the play in soccer, a tool serving the game. We should therefore be more demanding when training this important aspect of the game.

Below is a sequence of images depicting the chronology of a training situation of passes in American football. This situation is systematically trained in this sport because the game requires producing accurate passes to win. Isn’t that identical in soccer?

Starting position

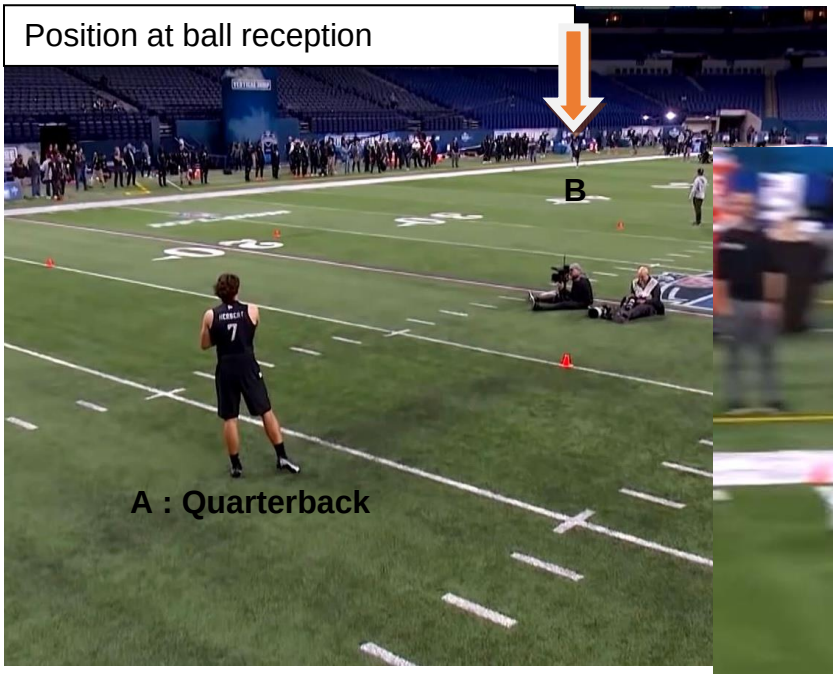


Intermediate position



Position at pass delivery time

Position at ball reception



Reception with a good timing (in the run)

4 Determining factors for choosing a pass

Before going further into the issue of « playing in the future », it is important to list all factors that can affect the style of passes that a particular player could favor. The player's choice can be influenced by internal (for example, his personality or physical/physiological profile) and external factors (social, cultural or specific training/tactical influences) he experienced throughout his life, or some combination thereof. These are detailed in the present section.

4.1 Internal factors

A typical starting question a coach should ask himself when beginning working with a player he does not know is: "I don't know this player, what factors make him/her passing the ball the way he/she does?". I try to address here some person-specific factors that determine the way of passing the ball (and by extension the way of playing). These factors are endogenous and can facilitate or inhibit the pass execution depending on the context.

4.1.1 Anatomical and physiological features

4.1.1.1 Theoretical aspects

4.1.1.1.1 Anatomy / morphology

The players' height, weight and limbs' morphology influence his movements. These are important factors to consider in a technical gesture like the pass. Typically, the motor execution speed is limited by such factors. Notwithstanding exceptional profiles, heavy players will need more time to mobilize all body parts that are involved in performing passes, hence lower speed execution is expected from them.

4.1.1.1.2 Physiological / sensorimotors aspects

Sensorimotor factors, or sensorimotor function (scientifically speaking), are sensory and motor processes that interact in order to allow individuals to perceive, understand and more generally interact with their environment. These processes are critical for the development of motor coordination, including both motor planning and execution levels.
Sensorimotor functions allow individuals to perceive and act using two types of information:

- sensory information informing about the state of the surrounding environment (vision of a moving object for example) or informing about our own body state (body orientation and postural balance/imbalance provided by visual, vestibular or proprioceptive sensors)
- "internal" information provided by mnesic processes (spatial or motor memory) or efferent copies (processed which allow us to predict the future consequences of our own actions: like the rotational visual flow that we anticipate when turning the wheel of a car / bicycle).

It is particularly important to note that the rate of growth of musculoskeletal and nervous systems can be different in young players. A 12-year old player can reach the height of a 15-year player (musculoskeletal level) but remain within his age range for the nervous system (the opposite is true). Taking into consideration this is worthy when dealing with any cognitive-motor training program, in particular for complex passes requiring high degrees of postural imbalances for example.

The combination of sensory and internal information flows mentioned above and their filtering through attentional processes result in a global scene perception: "*I perceive* a free space in the back of the defense / a teammate is attacking this space / I can pass the ball into this space".

This type of internal references is specific to a particular player. It can therefore change across players and across age periods for a single player.

4.1.1.2 Practical aspects

Some empirical / practice-based approaches like ActionTypes[2] (an approach based on individual motor preferences) emphasize the role of posture on the quality of perception hence on motor-perceptual coordination. In this particular approach, it is important to let players use their natural postural preferences to ensure that the technical skills are performed with a good timing.

I will not further develop this issue in the current thesis because it is a complex and ever-changing topic. Nonetheless, it was important to mention it here. I have indeed followed several Action Types training sessions over the past 10 years and I have also noticed during

[2] La bible des préférences motrices ActionTypes, Bertrand Théraulaz et Ralph Hyppolyte, Editions Amphora, 2021

my professional career how different the motor control functions can be across players. It is therefore important to let the player execute a motor skill following his/her own strategy. It is equally important to give young players sufficient amounts of time to test different ways of producing motor skills rather than imposing them a unique style / way of performing a motor skill.

For what concerns skills' assessment, efficiency should be favored over how these skills are executed. Two different technical gestures can lead to a same positive output. Following my experience, and my experiences with the Action Types approach, I would list the following preferences as particularly important for football and for a successful pass execution, in particular:

High and low frequencies

Every human being has a preferential visual field. Some first use central vision and then peripheral vision (a "high frequency" feature according to Action Types) and some behave the opposite way (a "low frequency" feature). This means that some players first focus on details (central vision) before shifting to peripheral vision (movement detection) while other players behave the opposite way.

Left and right radars

According to Action Types, and also related to visual flow, the « motor » eye (radar) is of great importance. Information gathering from this motor eye (radar) facilitates motor coordination hence technical skill execution.

Verticality or Horizontality

The need to maintain the body axis parallel to the direction of gravity or to create an angle between the body and the gravity vector are two distinct features (according to Action Types). In the first case, a player with a "vertical" preference will favor the alignment of visual objects along a single axis (player, ball, goals). In contrast, a player with a "horizontal" preference will favor a non-direct / non-aligned pattern, with angles between visual objects: for example, a ball arriving laterally before kicking it towards the goal. A "vertical" player would deal easily with a ball moving in the direction of the future goal while a "horizontal" player would prefer to move the ball (or his own body) laterally to create an angle before shooting the ball.

Below is an illustration of the difference between vertical and horizontal behaviors according to ActionTypes: a same situation (a direct free kick) is managed differently by “horizontal” and “vertical” players (pay attention to the direction of the red arrow).

Horizontal

Vertical

In the horizontal scenario, the player makes an angle (nearly 90 degrees) between the direction of his body and the ball-goal axis

Horizontal

In contrast, a more “vertical” player will stay aligned with the ball-goals axis.

Vertical

According to ActionTypes, such motor preferences are specific to players. One could think that these different technical strategies are under the influence of coaches during the training of young players, but more than 30 years of personal observations in football practice make me state that this is not the case.

A player using his own technique will generate more efficient skills/gestures than those produced using other techniques/preferences. A player can possibly perform all types of gestures but not all of them are “good” for him/her. Pushing a player towards preferences that are not natural for him require more energy and can lead to injuries.

The set of motor preferences of a player define his/her motor signature. This should be respected in order to reach efficiency when executing technical skills.

4.1.2 Psychological / mental factors

Self-confidence is fundamental in football: it allows more accurate technical skills and determines the ability of players to take risks.

Passing the ball towards an empty space wherein a teammate should run to receive the ball requires a great amount of confidence. Indeed, there are many unknown parameters in such a situation. A player with lacking self-confidence would favor a pass towards the feet of a teammate, a pass with a high hit rate.

Other cognitive and psychological aspects will be detailed later as they are more influenced by external factors (see next section).

4.1.3 Energy / Fatigue

In sports, fatigue is known to reduce levels of concentration/attention hence affecting mental and physical performance. Fatigue can also result in reduced motivation and self-confidence; it can also negatively impact the ability to take accurate and fast decisions as well as reaction times. For this reason, it is important to give sufficient amount of rest periods in order to facilitate recovery and optimize mental and physical performances. The fitter players are and the more they can resist to fatigue, the highest will be the playing performance.

4.2 External factors

4.2.1 Cultural aspects

A specific football culture of a country or a specific game philosophy of a club can greatly affect the playing (and the passing) behavior of a player. For example, this can result in a

playing style with passes executed towards the feet of the receiver or towards an empty space, in the run of the receiver. In the course of the football training, players systematically asked to play the ball towards teammates would encounter difficulties when required to pass the ball in empty spaces.

A more horizontal playing style with the intention to dominate the opponent team through high periods of ball possession is associated with playing the ball in the feet of teammates who should generate lots of runs without the ball in order to occupy the pitch. In contrast, a more vertical playing style with the intention to play fast and forward would favor passes in the empty spaces and “deep” runs to get the ball.

For many years, in particular in the 2000s, examples of two opposite styles were provided by FC Barcelona (horizontal, tiki-taka) and Real Madrid (vertical).

In rugby, a PhD dissertation thesis[3] by Julien Clément described how a “small” nation could compete with top-level world teams thanks to specific playing styles inherited from the fighting culture of the pacific islands.

4.2.2 Coaches’ influences

In football, the coach has a central role which is extremely important for players. The influence exerted by coaches over players is huge. The style of play and the coaches’ instructions will equally affect the passes executed by his team. High competing levels within a group can also bias (e.g. in order to gain a place) the passing behavior by choosing passing solutions favored by the coach. I will later detail the importance of coaching on players’ choices but it should be noticed here that a too interventionist/authoritative attitude of coaches can significantly reduce the creativity of players.

4.2.3 Level of involvement during task execution

The more a player feels concerned with the playing project of his team, the more he will try to apply what is required. This aspect depends on many features (leaderships, expertise..) of many people in the environment of the player.

[3] *Julien Clément, « Le rugby de Samoa : les techniques du corps entre "Fa'Asamoa" et mondialisation du sport », Thèse de doctorat de l’université d’Aix-Marseille 1 (2009)*

4.2.4 Environmental pressure and statistics

In modern football, a great pressure is put on players. Players became little “companies” that generate money and that hire several employees. Professional players must care about many parameters that can determine their market value and their career. Statistics / data exert an increasing influence on these aspects as well.

In addition to classical scouts’ reports on players, the production and analysis of detailed data related to players’ performance is quasi-instantaneously scrutinized by large amounts of observers, from expert scouts to TV watchers. Some clubs even structure their scouting strategy by first focusing on stats before taking the time to watch video footages of players’ performances. Among these data, passing stats are of great importance for selection processes.

In order to have good stats, a player could avoid “risky” passes (yet potentially decisive) and favor “secure” passes in the feet of the receiver. This aspect should not be underestimated as it is becoming increasingly important. Players’ agents also use such stats and put pressure on players in order to get attractiveness from the stats’ perspective.

4.2.5 Position on the pitch

Players’ roles and position on the pitch also contribute to influence the (type of) passes they perform during a game. Passes towards difficult-to-play spaces are often intended to strikers and are performed by midfield players or by defenders. Strikers would more likely pass the ball to supporting players or perform ‘deflected’ passes. The larger the space between a player and the opponents’ goal, the more likely the possibility to observe passes ‘in the future’.

In general, the closer is the pass to the opponents’ goal the greater is the pressure hence the more difficult it is to realize a pass. Higher percentages of successful passes are generally observed in defenders. The total amount of passes performed during a game is generally higher in central backs compared to a striker. A striker usually executes less passes than midfielders or defenders, but the pitch area wherein these passes are executed with a higher level of difficulty. A lower passing hit rate is therefore observed in strikers.

4.2.6 The concept of (social) affordance

Affordances are usually described as spontaneous interactions between the environment and what it offers in terms of action possibilities perceived by players (perception-action loops). According to the American psychologist Gibson, affordances correspond to the

perception of our own action possibilities (or that of teammates). Affordances in soccer are therefore also determined by the players involved in the collective actions. For example, a player does not play the ball to a deep space because he perceives that the running speed of a teammate would not allow him to get the ball, or because he knows that this particular player never attacks the deep space.

Thanks to his own experience within a team, a player constructs his perception of his own action possibilities and that of teammates. This will affect his future decisions.

4.2.7 Climatic conditions and pitch

Weather conditions (rain, wind, dryness and so on) will also affect the pattern of passes generated during a game. Other factors like the ground texture (natural or artificial grass) or quality, the pitch size also contribute to the 'passing behaviour' of players.

4.3 Extrinsic and intrinsic factors

A player constantly evolves throughout his career. The output of this evolution is shaped by extrinsic and intrinsic factors that determine his *experience* and *expertise*. A certain type of passing behavior is indeed shaped by all the passing situations he experienced. The more frequent is the practice, the more situations he experienced, and the more relevant should be the choices. Such choices are consistent with his own perceptual representations.

5 Missed or successful passes: the problem of judgment criteria

In order to address issues related to the quality and success of a technical gesture (a pass in our case), it is important to define relevant criteria for judging these aspects.
One can observe an ever-growing presence of statistics in soccer but many are not clearly formulated. Few years ago, counting the total number of passes performed by a player did not cause a particular problem. The current trend towards more elaborated and 'fine' variables and the "successful" or "missed" outputs can quickly become problematic.

Indeed, the very definition of a "successful pass" is problematic!

A same pass could be differently judged by two experts and both judgments can be correct. The interpretation depends on the game intention, the context, yet understanding a choice cannot always be possible (team strategy, particular moment of a game…). Judging the quality of a pass/choice requires having such information. The relevant assessment of an action in football therefore requires questioning the involved actors, that is, players.

Companies specialized in match analysis and content creation generally provide pass assessment based on somehow ambiguous definitions like the following one:
Accurate passes (P+): successful attempt to pass the ball to a teammate. When the teammate touches the ball, the pass is considered as "successful". If a duel occurs after the ball reception by the teammate and that the ball is lost, the pass is still considered as "accurate" (Instatscout).
This way of assessing the pass does not take into account the context in which the pass has been delivered, because this would require complex debates. The only criterion to classify this pass as being successful is the contact between the ball and the receiver: this does not provide relevant information for an expert.
In this thesis, I will consider the quality of a pass as a function of its efficiency. As my interest is focused on passes "in the future", the quality of the anticipation, the timing of the runs and the weight of passes are fundamental to guarantee its success.
I will mainly rely on these parameters to judge whether a pass is successful or not. Of course, the context is important as well. A pass can be perfect from one point of view (the weight of passes for instance) but it can be a missed pass if the opponent intercepts the ball. The whole situation should be taken into consideration in my approach.

6 The types of errors determining pass failure/success

As mentioned earlier, judging the error is dictated by the context: I will therefore apply efficiency as a tool for assessment. I am aware that efficiency can be viewed as a subjective criterion but eventually, soccer is not an exact science. In soccer, everything can be considered as subjective but the final score. In fact, following soccer shows with incessant debates on referee mistakes / unclear game situations demonstrate that it is hard to find a consensus.
Furthermore, before expressing a definitive judgment regarding a pass, it is necessary to consider the intention of the player. In order to identify one of the errors I will describe later, it is important to get feedback from the player. Simply analyzing the images does not allow, in most cases, to reveal the intentionality. Errors are here categorized in two types.

6.1 Factual (individual) errors

A broad definition of the error is the difference between a desired state and the current (real) state. One could define a factual error as a difference between a desired target (position and time) and the (actually) reached target (position and time).
In the context of pass efficiency, a pass that serve the play, I propose to define the factual error as a difference between a position/desired timing (to create a game imbalance for example) and a position/timing really observed.

Factual errors can be attributed to passers or to receivers. The two players involved in the pass should have similar intentions, but the passing execution level and/or the movement of the receiver may not allow the success of the action.

Below is a listing of the different types of factual errors that I will explain with concrete examples. It should be noted that a missed pass is rarely provoked by a unique cause (technical, cognitive…) but for sake of simplicity, the following categories are established based on the most salient cause/component of the measured error.

6.1.1 Motor/Technical Error

This error is caused by a bad gesture execution. For example: *a ball intended to be passed at floor level but arriving at the knee level, making it difficult to control.*

6.1.2 Conceptual / Cognitive Error

The error is here dominantly caused by a bad interpretation of the game situation. This "reading" error is of no benefit to the game. For example: *a player passes the ball while being under no pressure and the ball is intercepted by an opponent who anticipated the pass.* In this case, a better solution for the player would have been to progress with the ball, hence winning space. Such pass might have reached the receiver in the absence of interception, i.e. the pass is correct in terms of technics but bad in terms of tactics/strategy/cognition.

6.1.3 Motor / Cognitive Error

Here, the choice of the passer is relevant (i.e. a good recognition of the situation and a good intention); however, the ball doesn't reach the expected area in the expected time. For example: *the player sees a deep run of the receiver, he plays the ball to a 10-meter-deep zone but the pass is too short. The pass doesn't respect the rhythm/speed of the teammate's run hence the timing is bad.* A deeper zone (20 m for instance) would have allowed gaining advantage over the opponents, but this is not the case because the receiver has to decelerate/stop to get the ball.

This error is therefore not of pure technical origin because it is tightly linked to the context and to a bad estimation of the future receiver's position (perceptual/cognitive error). Such an error would not be generated if the passer would have executed the pass in a "raw" situation (i.e. without the dynamics of the situation/action), that is, passing the ball to a 20m-deep zone free of opponents/teammates.

Alternatively, a problem at the motor preparation stage could be considered: the decision to play the ball to the 10m-zone is relevant but the pass is triggered too late, or the power of the pass is not adequate (too strong/weak), resulting in a missed pass. The same could occur in case the pass is triggered too early.

In fact, it is hard to distinguish between purely perceptual/cognitive and motor/technical factors and it is likely that errors are produced as a combination of these two factors.

Importantly, it should be noted that the cognitive error can be shared or completely caused by the receiver. For example: the pass is executed in the correct timing but the receiver changes his run direction/speed because of an incorrect reading of the ball trajectory/bad interpretation of the game situation. All these hypothetical scenarios result in a missed pass.
This type of situation is at the core of my thesis. This problem is often observed in football but is not systematically linked to the cognitive aspect. Conversely, pointing to a technical problem is a shortcut that prevents coaches from deeply examining the real causes underlying the error.

6.2 Shared or collective errors

This type of error is clearly the product of a bad synchronization between the choices of two teammates. For example: *the passer passes it in the feet of the receiver but the later anticipated a pass in the deep space*. The situation offers both solutions in terms of passes but the synchronization is not good. Which player should be the referent player? The player waiting for the ball should offer a solution by a run and the player with the ball should then pass the ball towards him or take another decision.
As players often try to mask their intentions (to the opponents) until the last instant in order to perturb opponents, there is a risk for the passer to be perturbed by a sudden run of the receiver in between information gathering and pass execution. This can typically be observed during movements / counter-movements of teammates that are generated to perturb opponents.

7 A detailed analysis of the cognitive-motor error

7.1 Preliminary investigation

I will start this section with research I have performed during the course of this thesis work. I sent a picture of a game situation to several expert or amateur soccer practitioners. These are coaches, players or fans.

Below is the instruction provided to them:

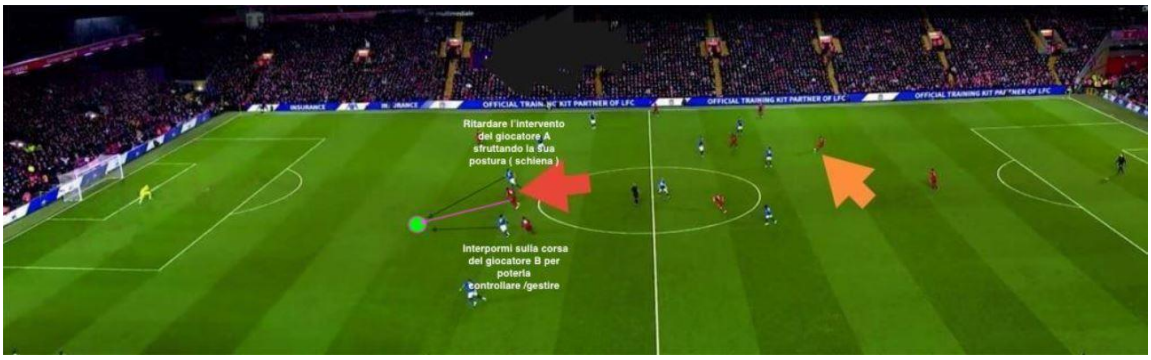
⚽ 🟢 FOOTBALL STUDY : in the following image/situation, a ball is played by a player from the red team (orange arrow). This is a decisive pass (assist) which ultimately results in a goal scored by his teammate (red arrow). In your opinion, where did the striker first control the ball before scoring? (Important: the striker scored the goal after the control, without any duel with the opponents/defenders).

You are required to indicate your response by adding a circle depicting the (estimated) zone of ball control by the striker and send me this image. Thanks in advance, Vincent.

Going deeper into this situation, I realized that the reading of this action was not trivial even for experts. That is why I performed this small research which provided interesting findings. I present here typical responses selected from 50 participants.

a- Below is the response from a) 44y-old Swiss professional coach (UEFA Pro) with experience as assistant and first coach in the Swiss Super League.

b- 59y-old swiss coach (UEFA A) with 30 years of experience in the youth elite football sector (M12-M16).



c- 45y-old French coach (UEFA A) with several years of experience as first coach in elite (national) U15-U17 players.

d- 43y-old Swiss coach, first coach with a youth national team.

e- 58y-old Swiss coach working in the youth (junior) elite football

f- 39y-old amateur player and football fan.

g- 13y-old football player

Here is the actual zone where the ball has been controlled during the striker before scoring the goal;

This little research allowed me understanding that the perception and reading of a game situation is not accurate for what concerns my main topic, « playing in the future ».

We (expert coaches) are not used to perform many calculations on this type of passes and, (in my opinion) it is therefore not surprising that our players encounter difficulties in executing such passes.

As can be observed from the received responses, the estimated position of ball reception is far from the real one (and from the goalkeeper) for a huge majority of questioned participants. This might explain why so many passes are played that short in real games and are intercepted by defenders.

In order to improve that, it is necessary to repeat such situations during training. It is equally important to provide feedback that would allow players knowing whether such passes are corrected executed or not, and how they can improve this skill. I will address this issue later in this manuscript.

7.2 Cognitive-Motor Error: theoretical aspects

In the Introduction, the Cognitive Motor Performance has been defined as the ability 'to quickly gather game-relevant information and use this information to adequately execute a certain motor task'. Indeed, cognitive and motor aspects are tightly linked in all game situations in soccer.

Perception is therefore an active process wherein important flows of (physical) information are gathered by different sensory modalities and transformed into a particular perception of the physical environment/reality. It is important to note that the perceived scene is composed of less information compared to the real scene: this is due to information filtering/selection processes (e.g. attention and memory). Such attentional filtering can, to a certain extent, be considered as a way of selecting task-relevant information. A same situation therefore generates different percepts/decisions across individuals, and this hugely depends on the "motor profile" of the player. The cognitive dimension (perception/decision) is therefore strongly coupled with the motor dimension (action possibilities).

In this context, the cognitive-motor error can be the result of a bad assessment/estimate of its own action possibilities (or that of a teammate) or incomplete information gathering leading to hasty judgments. These different scenarios are detailed in this section.

Because all this happens at high speeds, often instinctively, it is not easy to identify which part of the cognitive processes led to errors. This is particularly true considering that different processes work in parallel, for example during the anticipation stages where players do not wait for the full amount of information before taking decisions to act. As far as passes are concerned, the correct prediction of the future ball position depends on the initial receiver's position and running speed/direction. Timing between teammates is therefore of great importance. In some cases, even with good intentions, passes are missed because of a bad timing. These different levels of analysis led us to propose the following methodology/terminology.

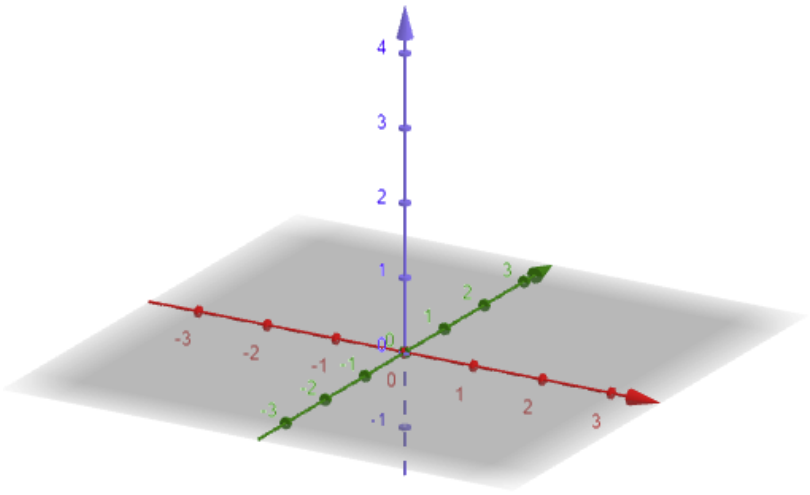
7.3 Cognitive-Motor Error: methodological aspects

Below is a list of the different possibilities for passing errors:

- The passer plays the ball too early
- The passer plays the ball too late
- The passer plays the ball with a good timing

- The player without the ball (receiver) arrives too early in the final zone (zone targeted/intended by the player performing the pass)
- The receiver arrives too late
- The receiver performs an ideal run to the final zone

One can illustrate these possibilities using a 3D-graphics. Any situation close to the origin of the reference frame would allow creating imbalances in the game and producing efficient and smooth actions:



Passer's Timing : negative values correspond to 'too early' and positive values correspond to 'too late' execution, respectively. A value close to 0 corresponds to a perfect timing.

Receiver's Timing : negative values correspond to 'too early' and positive values correspond to 'too late' execution, respectively. A value close to 0 corresponds to a perfect timing.

Passing accuracy: negative values correspond to 'too short' and positive values correspond to 'too long' execution, respectively. A value close to 0 corresponds to a perfect passing length.

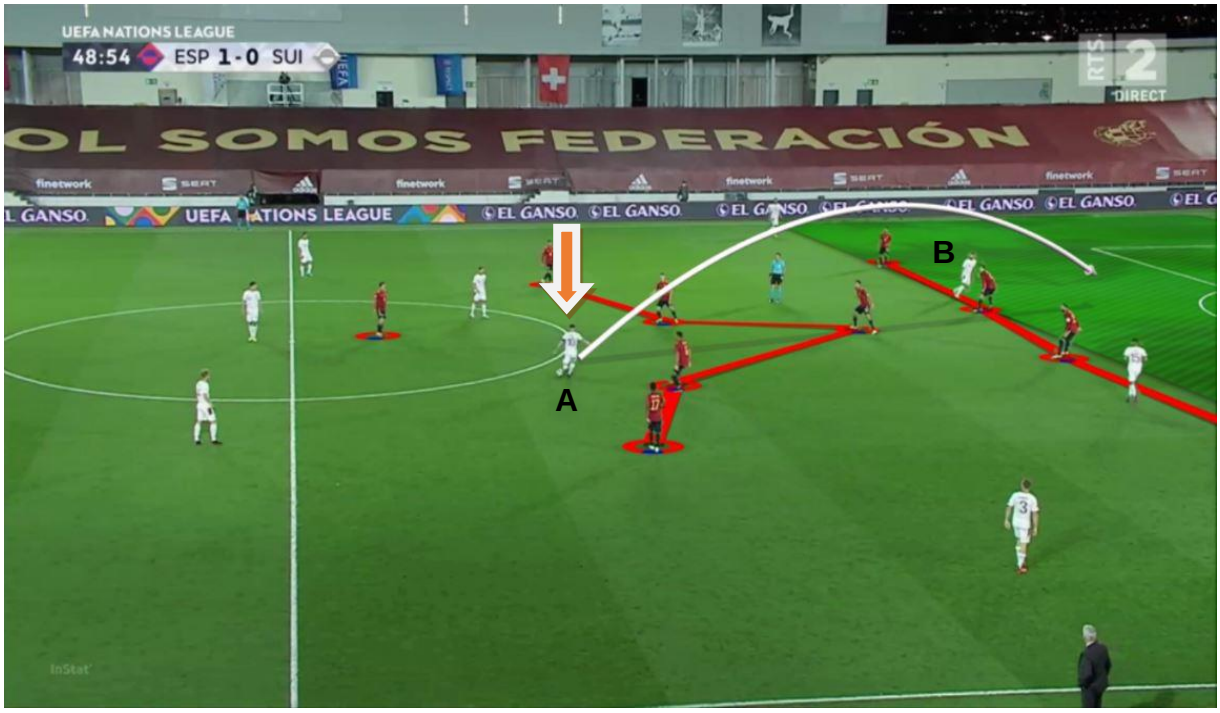
I present below examples of situations encountered in matches and personally discussed with the players after the match. One should focus on the pass performed by A to the receiver B. The orange arrow depicts the first impact of the ball (by B) following the pass.

In example 1, the pass is too short while the pass is not played in the relevant zone in examples 2 and 3. I emphasize that such situations are usually not identified as cognitive-motor problems but as simple technical errors.

Example 1 :

The ball is passed too short – the pass is played to the initial receiver's position and not the final zone that the receiver would have reached following his run/move.

Situation before the pass :



Situation after the pass: the pass is too short (and intercepted by the defender). The yellow dot on the bottom-left corner of the graphics indicates that the timing between teammates was good but the passing length/force was not.

Example 2 : the pass is too long. The passer estimation of the final position of the receiver is not correct (bad estimation of the receiver's running direction/speed).

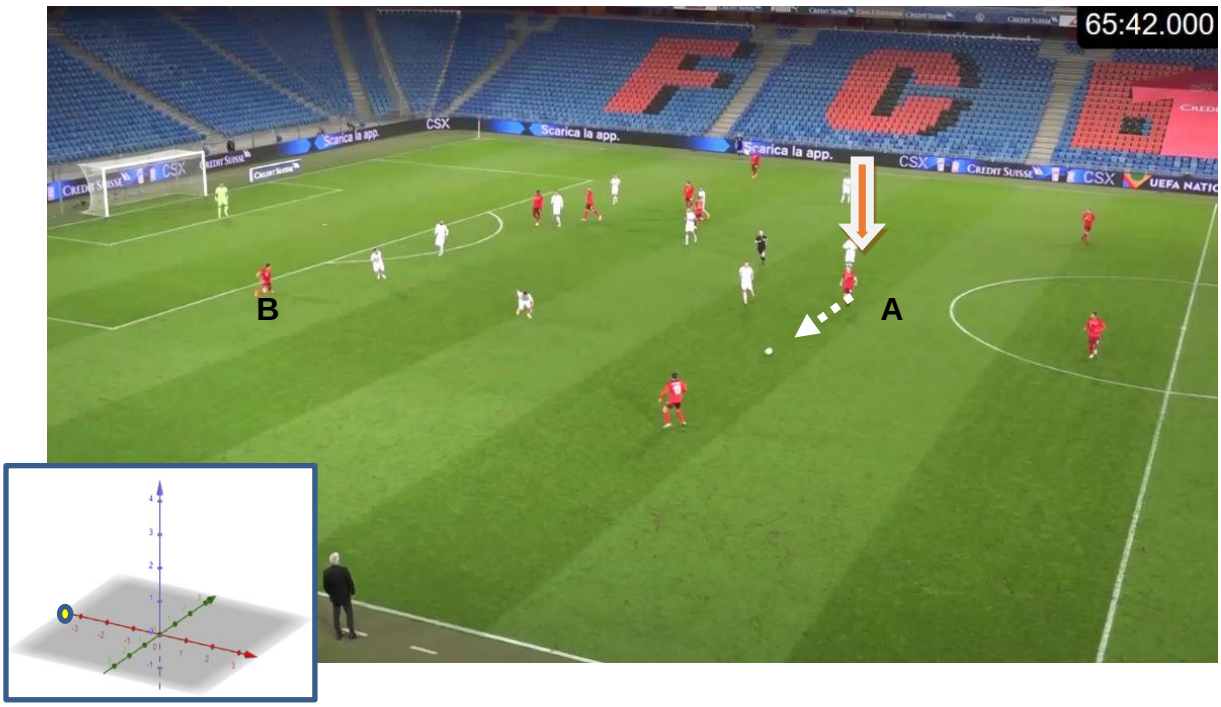
Situation before the pass :

Situation after the pass: the pass is too long.

Example 3 : the pass is not executed by the passer. The passer correctly identified the situation but did not feel good with playing such passes. The error is here determined by the choice not to play a potentially decisive pass;

Situation before the pass :

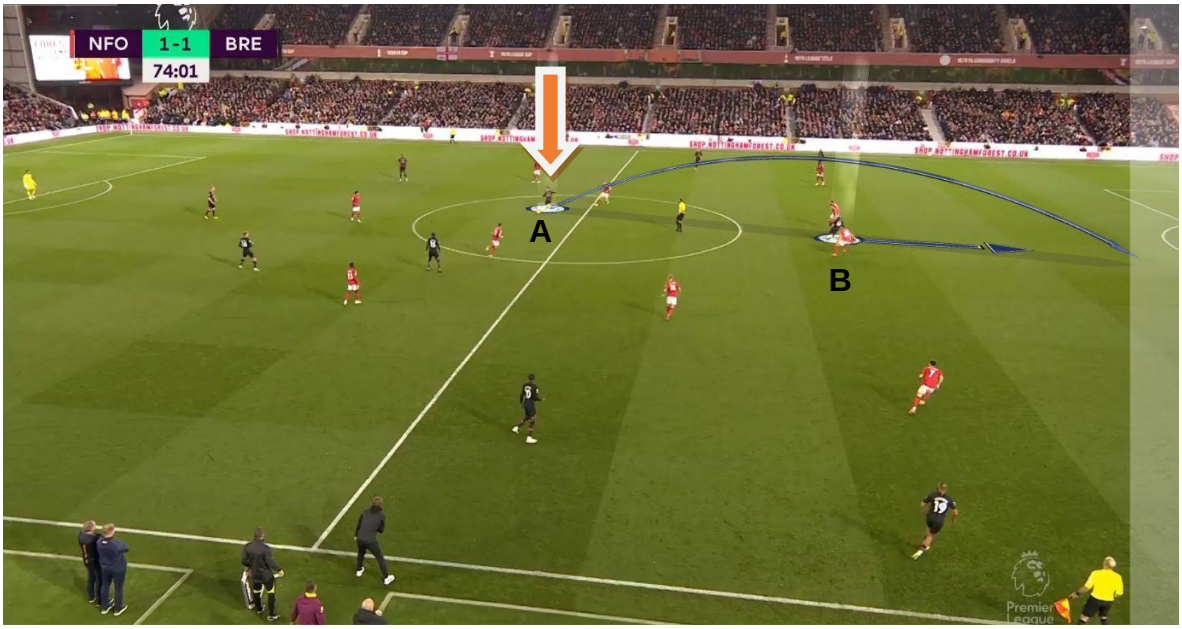
Situation after the pass : the pass is not played.



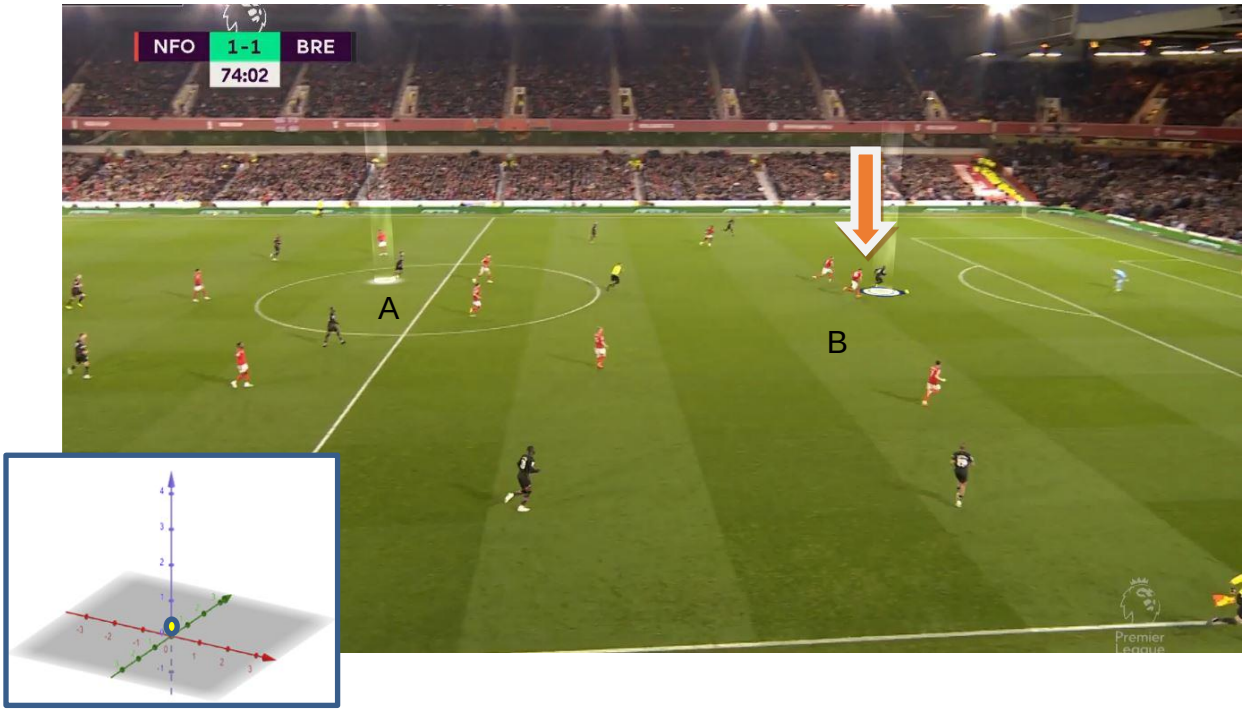
Example 4 : when everything goes well/smooth, if often results in a goal.

Situation before the pass : the passer A receives the ball and has already perceived the positions of B / Defenders.

A plays the ball in the space behind the defense and B anticipated this pass by attacking the empty space via a sprint.



Situation after the pass : the ball is perfectly played in the relevant empty space with a relevant timing.



B takes advantage over defenders thanks to his anticipatory move and wins his duel / scores the goal. Perfect timing led to a goal !

In conclusion, I would like to emphasize that the perfect execution of a pass is not trivial if we take into account all these factors.

When a pass is perfectly played, the action smoothness makes it a simple move in the eyes of the observers. In contrast, performing it successfully requires expertise. Succeeding in such actions on a regular basis cannot occur by chance.

I don’t think that coaches should spend a lot of time in analyzing which part of the cognitive process failed in the case of bad passes; rather, they should be aware that cognitive (and not only technical) aspects contributed to failed passes.

Indeed, not recognizing such aspects would not allow us thinking about how to improve such skills.

8 Reflecting on the contents of training sessions

8.1 Results from a scientific study on the timing of passes in soccer

I have co-authored a study [4] on the timing of passes. The study was led in 2018 by Dr Halim Hicheur, a neuroscientist/sport scientist then at the Department of Medicine of the University of Fribourg (Switzerland).

Halim was looking for a soccer academy in Switzerland to test his hypotheses / high-technological simulator; In particular, he focused on ways to quantify/improve cognitive and motor skills in soccer. As the head of the academy, I was in a privileged position for following Halim's work and our exchanges opened my mind on this topic.

Summary of the study

Purpose

In this study, we tested the hypothesis that augmented feedback (AF) training can improve both perceptual–cognitive and/or motor skills specific to soccer.

Methods

Three groups of young elite players (U14–U15 categories) performed a test consisting in passing the ball as accurately and as quickly as possible toward a visual target moving briefly across a large screen located at 6 m from the player. The performed task required players to correctly perceive the target, anticipate its future location, and to adequately adjust the pass direction and power. The control group (CON) performed normal soccer training and was compared with two visuomotor training groups (AF and no-feedback [NF]) that followed the same training regime but integrated series of 32 passes three times per week over a 17-d period into their normal soccer training. Objective measurements of the passing performance were provided using a high-technology system (COGNIFOOT) before, during, and after training. During training, only players of the AF group received visuo-auditory feedback immediately after each trial informing them about the accuracy of their passes.

Results

The results show that only players of the AF group significantly improved passing accuracy, reactiveness, and global passing performance (+22%), whereas the NF group only improved

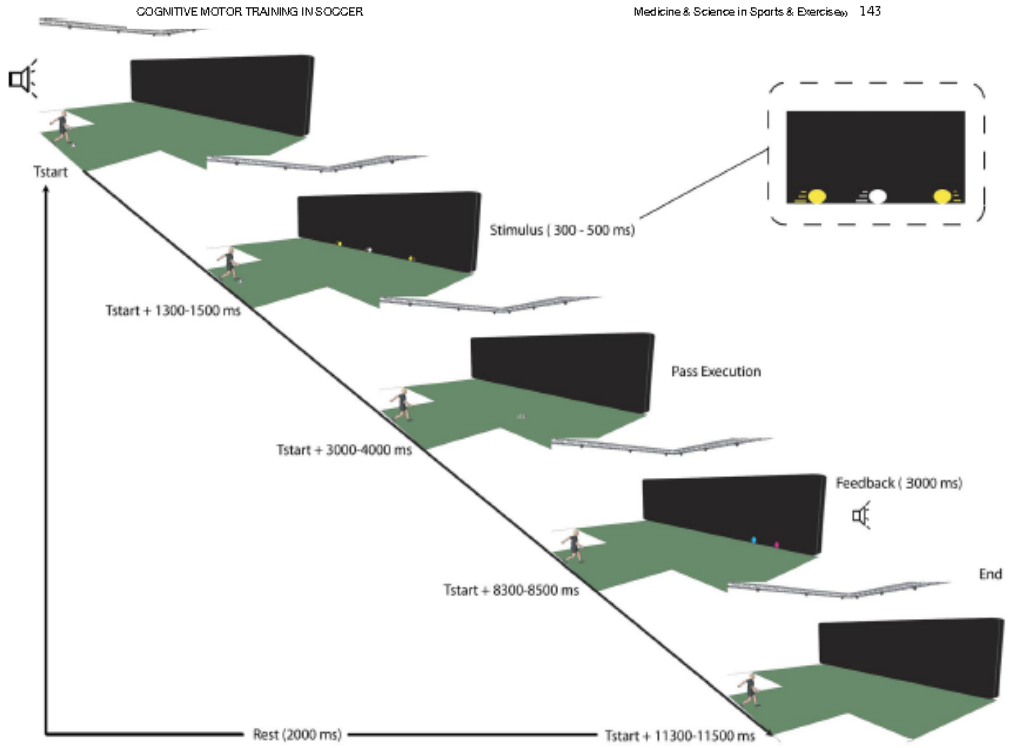
[4] *Hicheur, H., Chauvin, A., Cavin, V., Fuchslocher, J., Tschopp, M., Taube, W., Augmented-Feedback Training Improves Cognitive Motor Performance of Soccer Players, Medicine & Science in Sports & Exercise, 52(1),141-152, (2020)*

passing accuracy. None of these parameters was improved in the CON group. The objectively measured changes in passing performance were compared with the more subjectively judged passing performance provided by coaches and players. Coaches' judgments were more reliable than players' judgments and exhibited a training group effect comparable to the ones objectively measured by COGNIFOOT.

Conclusions

This study provides evidence that the training of cognitive motor performance in soccer players highly benefits from the use of augmented feedback.

The passing performance of players from our academy have been measured using a soccer simulator coined COGNIFOOT (see images below). Players were immersed in a small game field (10m length x 10m width artificial grass) and were facing a huge screen (4m height x 10m width). Players were required to react as quickly and as accurately as possible to visual stimuli displayed on the screen. They did so by kicking a real ball and their responses were recorded in real time via high technological motion capture cameras. Parameters like passing accuracy, response times passing speed but also anticipatory levels (the distance between the ball impact on the screen and the position the moving target would have reached at this instant, like the timing between passers and receivers discussed previously) have been quantified.



In the situations studied with our players, a moving white circle was displayed on the screen for a short duration (typically 500 ms). The circle appeared at different possible starting positions (left, center or right), moved at different possible speeds (left or right directions, slow-normal-fast speeds) and moved alone or in presence of two visual distractors (yellow circles moving in random directions). All these possibilities were run in a random order. Players were asked to kick the ball so that the ball would have hit the screen at the position the moving (disappearing) target would have reached it if would have pursued its movement. So the task required players to correctly estimate the target speed/moving direction in a way similar to the timing between passers and receivers' runs discussed previously).
All players performed an initial familiarization tests (32 passes) and were then separated in three groups of 9 players each:

- The control group (CON) performed normal soccer training after the initial test and performed a second test after around 20 days
- The Augmented Feedback AF group integrated COGNIFOOT series of 32 passes three times per week over a 17-d period into their normal soccer training. After each pass, a visual and auditive feedback indicated them the accuracy of their passes
- The no-feedback [NF]) group followed the same training regime as AF but did not receive any feedback during training sessions.

After one month, the initial test was repeated in the three groups. The results show that only players of the AF group significantly improved passing accuracy, reactiveness, and global passing performance (+22%), whereas the NF group only improved passing accuracy. None of these parameters was improved in the CON group.
This research dealt with the 'playing in the future' issue addressed in this thesis. The challenges raised by such methodologies and the progresses after only one month of training made me think a lot about passing situations in modern football. Indeed, I first observed that many of our players systematically under-anticipated the motion of the target (which roughly reproduced the situation of the running teammate). This made me focus on this aspect also for the real matches/games played during that period. Indeed, many players delivered the pass too late or with non-optimal timing.
Since this scientific/training study demonstrated such fast improvements thanks to repetitions of passing situations and frequent feedback, I also thought about how this could affect the way we train our players. Although soccer is a dynamic game with many players'

movements, we hardly find a way to respect this dynamic feature when training passes' execution.

When I speak about 'our' training, I certainly generalize because there are as many training protocols as coaches in the world of soccer. Nevertheless, I have visited many professional clubs and academies, and it seems to me that this particular topic/theme is not clearly identified and specifically trained in most of soccer pitches I have visited.

8.2 Reflecting on applying theoretical insights to the pitch

I will here develop on two aspects.

8.2.1 Game reality and proposals of training situations

Players are not often trained to improve the quality of their passes 'in the future', in empty spaces reached by running receivers.

In most of our training sessions, passes are usually required to be delivered in the feet of teammates. Ball possession inside square or rectangles is often performed using external support players. Balls are played towards external or internal support players in the context of a high density of players. All these forms of all possession training are aimed to train technical skills of players under high pressure in reduced spaces.

The number of players per m² of pitch ratio encountered in a real match is nearly never respected during training. The risk of doing so is that players may not learn/pay attention to exploit available spaces. I will list here training exercises while explaining the rationale behind such exercises. My goal is not to detail the theoretically infinite range of training contents in football; rather it is intended to broaden our view on the size of playing spaces.

8.2.1.1 Ball possession and very small sided games

Here are few examples:

This exercise is typically used at the beginning of the training session. This form of possession training can be adapted to a certain size/shape of pitch and to a specific number of players (8 vs 2 or 8 vs 3). Players who have numerical superiority shall execute a maximum number of passes and defenders try to recover the ball as fast as possible. Most often, players with the ball are nearly static and passes are delivered to the feet of receivers.
Below is another example of exercise often used at the beginning of the session, a variant of the simple 8 vs 2 described above.

Here the team with the ball shall perform 5 consecutive passes inside the left square before playing the ball in the right square where 3 players are standing. Two opponents can defend. When the ball is played in the opposite square, four players of the “possession” team support the three players and two new blue defenders also integrate the play and try to recover the ball. In this exercise that can be shifted to a game, one can usually count the number of passes from one square to the other and the number of interceptions. A variant with 3 teams can also be tested. Two teams should possess the ball in each square and the third team defends starting from the central zone between squares.
In these different situations, the pressure is high and passes are mainly played in the feet. It is very rare to observe a pass played in the run of a teammate.

8.2.1.2 Ball possession and small sided game

Below is a more global form of ball possession (8 vs 8 with 4 support players).
Here again, the team with the ball should try to perform a maximum of passes and avoid ball recovery by the other team. In this exercise, space can be adjusted as a function of the goal,

but it is often reduced to ensure high physical intensity and technical training under pressure. To make it more enjoyable or fun, points can be given after a certain number of passes or every time the ball goes from one support player to another. The ball is either player towards the support player or inside the field (by the support player). In both cases, passes to the feet are favored because of the short runs performed by players. Indeed, given the configuration/space, long runs in empty spaces are never performed.

8.2.1.3 Real game and small sided games

Even when 11 vs 11 games are used during training, pitch dimensions are often reduced.

This example of 11 vs 11 is often used during training. The pitch's length can also be limited by the 16m line at each side of the pitch. Again, such space reduction prevents players from attacking empty spaces behind the defensive lines, as can be observed during a real game.
Taken together, such situations used during our training sessions do not match those of a real game. The actual tendency is indeed to reduce spaces in order to augment physical intensity and decision-making time under pressure. Although this allows improving players' performance in reduced/small spaces, it is not evident to generalize it to the whole area encountered in a real competition game.
Remarkably, such methods do not put players in situations where they could train their 'passes in the future'. In particular, timing errors in small-sided games cannot be easily noticed in contrast with what could observe in real games where 20 or 30m runs are significantly more challenging in terms of timing. This lack of systematic training of long passes may explain the poor performance of players in such situations in real competition. Interestingly, many players acknowledged that and told me that they often avoid playing such passes.

8.2.2 Realistic training situations and coaching limitations

In addition to the problematic raised by the exclusive use of reduced game spaces, coaches' instructions can also be detrimental to the performance/training of passes in the future. In fact, such instructions can be missing or inappropriate. The absence of feedback can limit the improvements of players and players are often unable to produce self-judgments on the quality of their passes under such circumstances.

Rather, coaches should support/advise players during training particularly for players with poor performance for such type of passes. Coaches' expertise and feedback are definitely needed. Once again, such situations are unfortunately quickly documented as technical errors rather than emerging from cognitive-motor problems.

Any training program missing this issue would hardly help player to improve such specific passing skills. Training technical skills while respecting the dynamics of the game should be a top priority. Players should perform equivalently well when passing the ball either to a 30m-distant static receiver or a 30m distant running receiver.

Importantly, the role of the receiver is critical for improving skills of the passer: coaches instructions should therefore focus on the collaboration/exchanges between the passer and the receiver. Players are sometimes more receptive to remarks provided by teammates than coaches. Anyhow, the presence of a feedback (wherever it comes from) should make passers aware that they can improve such passing skills.

Repeating such skills within the game dynamics and the presence of feedback should create a new intentional anchoring in players and eventually lead to improvements.

The level of demand from coaches for what concerns such passes is also a very important point to consider. The demand should be primarily pointed to the respect of the game/action rhythm. For example, the fact that receiver shall decelerate their run to get the ball should be used as a marker of a bad pass execution. The type and level of demand from coaches will directly affect the concentration of players hence the quality of passes. Being demanding should not be associated with being ‘negative’ or ‘over-critical’. Coaches should here be supportive of players and explain clearly the goal of training such skills.

In summary, training of players over the past years has mainly been based on playing the ball in the feet of teammates. The Tiki Taka style developed in Barcelona FC had a great influence all around the world and the possession games described earlier are used in almost all training pitches. As a result, one can observe only few players attacking deep/empty spaces hence few passes ‘in the future’. Receivers performing such vertical runs are rare and are often valuable players.

A current tendency for more attacks on empty/deep spaces, more game verticality… should therefore favor the training of passes in the future.

9 ‘Playing in the future’ : proposition of exercises

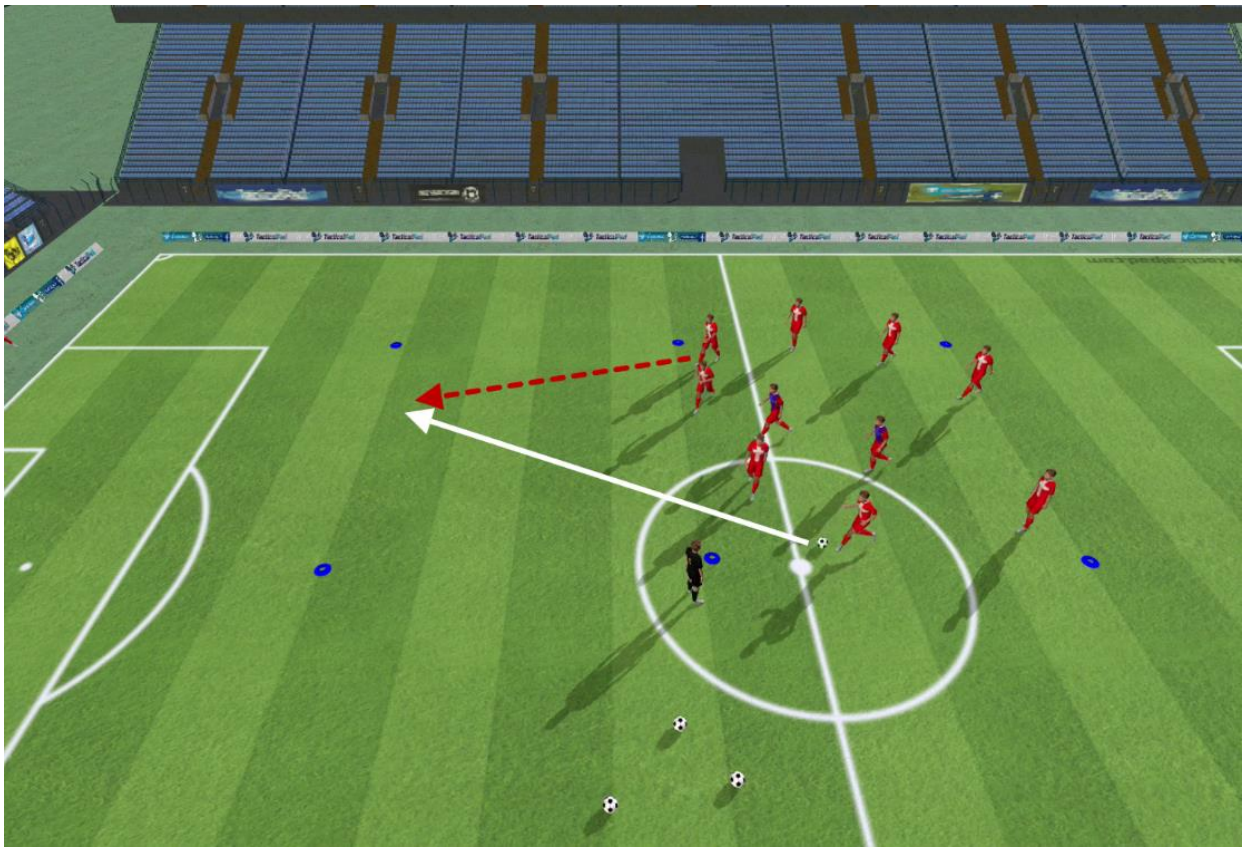
Following what I have been describing in the preceding sections, I do believe that a huge door of improvement exists for what concerns ball possession phases and offensive animation.
Even high-level teams exploit only a small amount of their offensive/attacking possibilities. Improving our ‘game/play in motion’ through passes in the run of receivers/respecting the playing rhythm should increase the efficiency of our attacks.

This requires an evolution of our training sessions. Conceptualizing exercises promoting passes in the run of players and adapting adequately the pitch dimensions are two important tools underlying such evolution. One could build on experience/expertise developed in other sports like (American) football, as described in the first part of this thesis.
I will propose several examples of exercises going into that direction. The goal here is not to be exhaustive (each coach can test his own exercises); rather, it is dedicated to creating an evolution of the common exercises described earlier.

9.1 Ball possession and SSG Variation

Let us start with the ball possession exercises used at the beginning of training sessions. Rather than using fixed dimensions and shapes of pitches, modifying the spaces during exercises should lead to more passes in the future. Playing with the game rules is therefore a first tool to achieve our goals.

Reconsidering the first exercise described in the previous section:



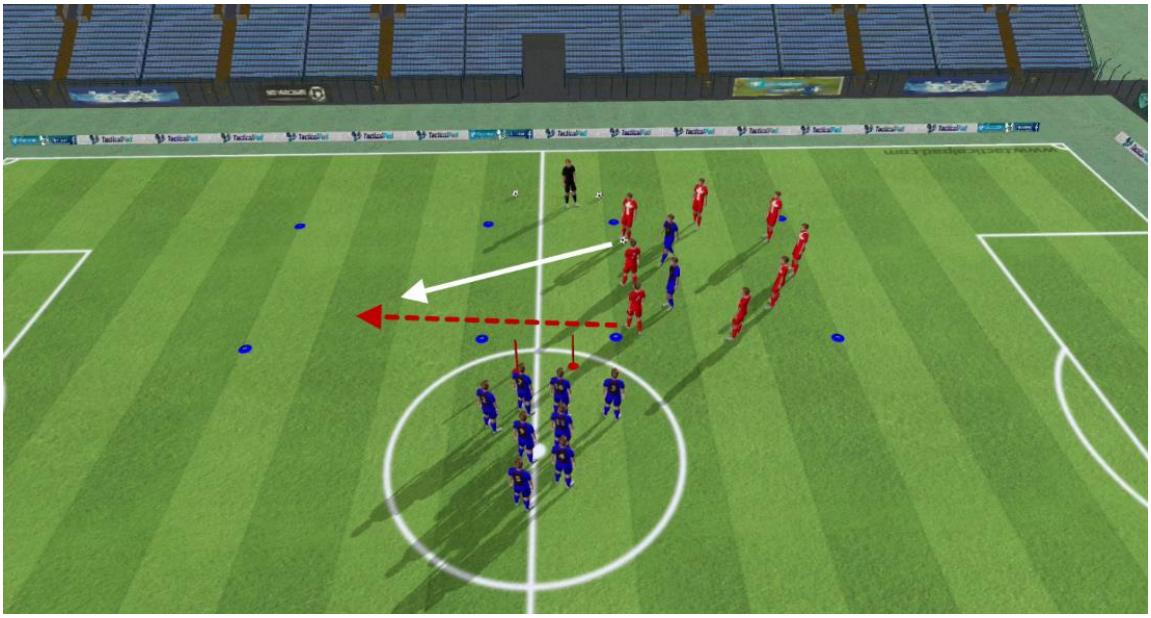
Here, a second (or a third or fourth) empty space (here a square) is created in my 8 vs 2 game. The presence of an empty space, and the instruction valuing the transition towards this space should favor the execution of passes in the future.
Here are two possible instructions:

- The transition to the empty space should occur after a minimum of 5 passes and a maximum of 10 passes; this emphasizes the idea of possessing in a certain part of the pitch and reverse the play in a new zone
- In order to integrate the offside idea, rules preventing players from moving too early to the empty spaces can be proposed (no player in the empty zone before pass execution)

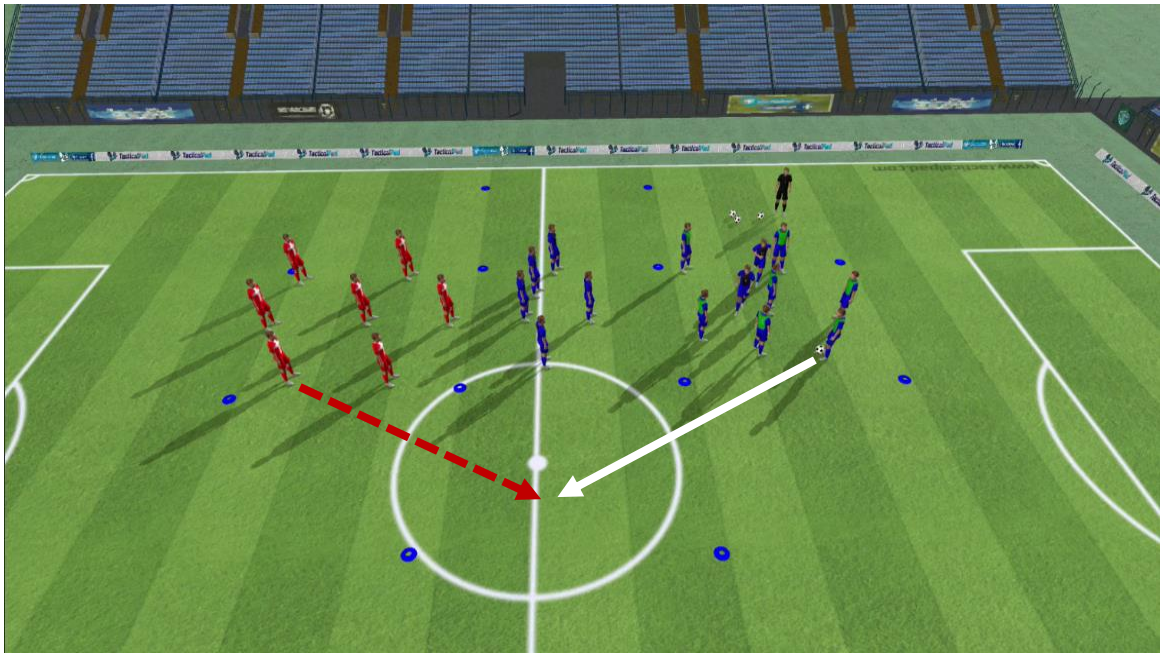
Reconsidering the second exercise described in the previous section:

Here, the organization remains identical to what previously described except that no players are waiting in the opposite square. This opposite square should be reached by the passer through a ball played respecting the run of the receiver.

The same instructions as described in the previous paragraph can be used for this particular exercise (number of passes and offside…).



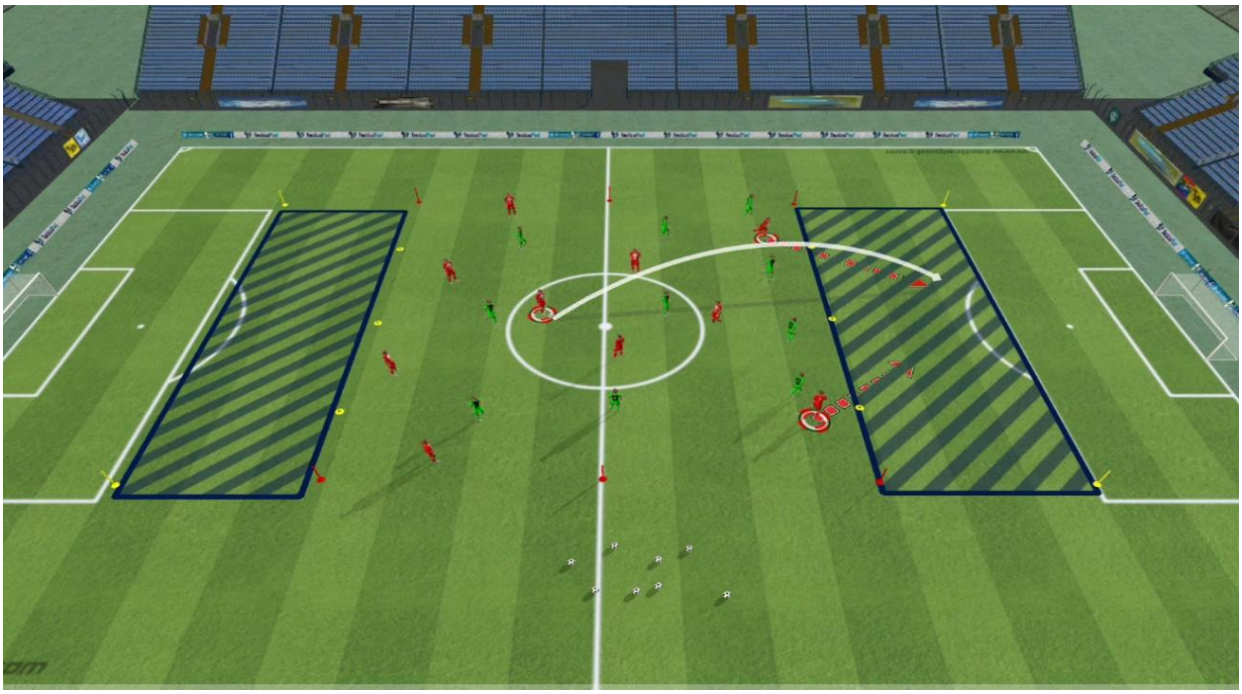
Similar exercises with 3 teams and 4 squares :



9.2 Ball possession and reduced spaces

Here are adaptations of the ball possession game with support players presented earlier. Rather than placing players on the sides (therefore losing the vertical/deep game possibilities), I propose (in dashed line below) two zones where the running receiver can control the ball. The idea is to enter the zone only once the ball is played by the passer. If the ball is controlled by the receiver in this zone then the team gains one point. The team can also gain 1 point if 10 passes are performed within the main ball possession zone.

This new form of exercise favors two goals: ball possession in a reduced space and the attack of an empty/deep space.



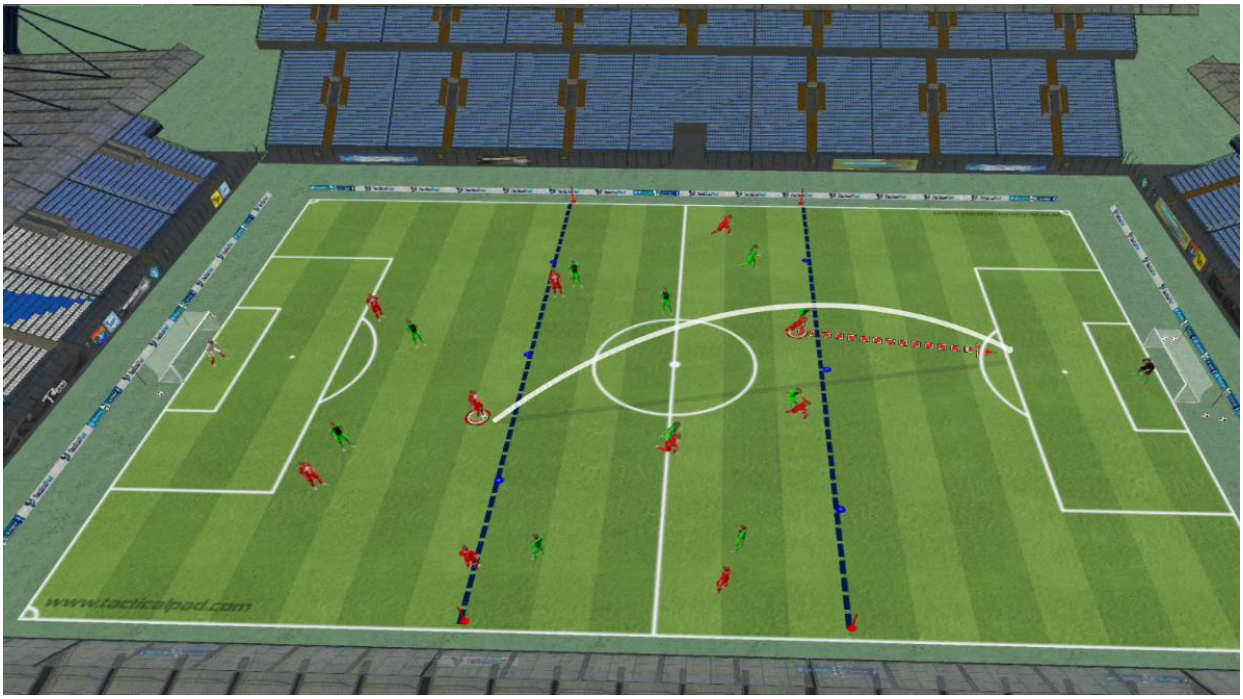
A little familiarization time is expected to have all players engaged at 100 % in this type of exercises. After practice, this form of game should offer different options to players and generate more runs in empty spaces.

9.3 Real game and reduced space

This 11 vs 11 form of game is closer to a real competition game;

As depicted below, the pitch is divided into three zones. The two teams should always be playing in two (adjacent) zones. The last zone remains empty unless a passer delivers the ball / receiver runs towards this empty zone. The central zone imposes the defending team to remain in ‘high’ position during the possession of the other team. The ‘construction’ zone can be used by the team with the ball without restrictions and the opponent team can also enter this zone. No player (including those of the defending team) can enter the empty zone before a ball is played there by the passer.

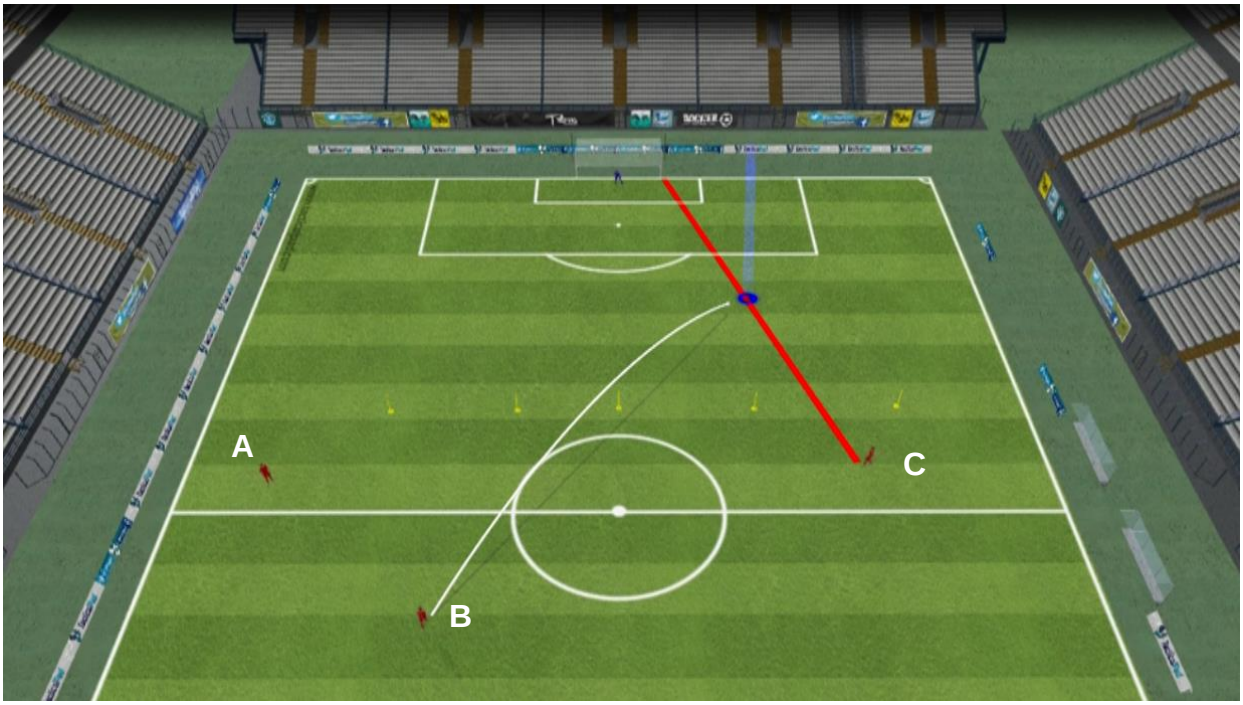
This form of real game in close to real situation offers the possibilities to produce runs behind the defensive lines and to train the timing of passers/receivers in a large space. The idea is to favor runs of the receivers towards the empty space.



9.4 Specific form

Here are some more analytical examples dedicated to making players more familiar with the execution of such cognitive-motor skills.

The image below depicts a situation I have proposed to a player who experienced difficulties in finding the good timing of passes behind the defensive lines.

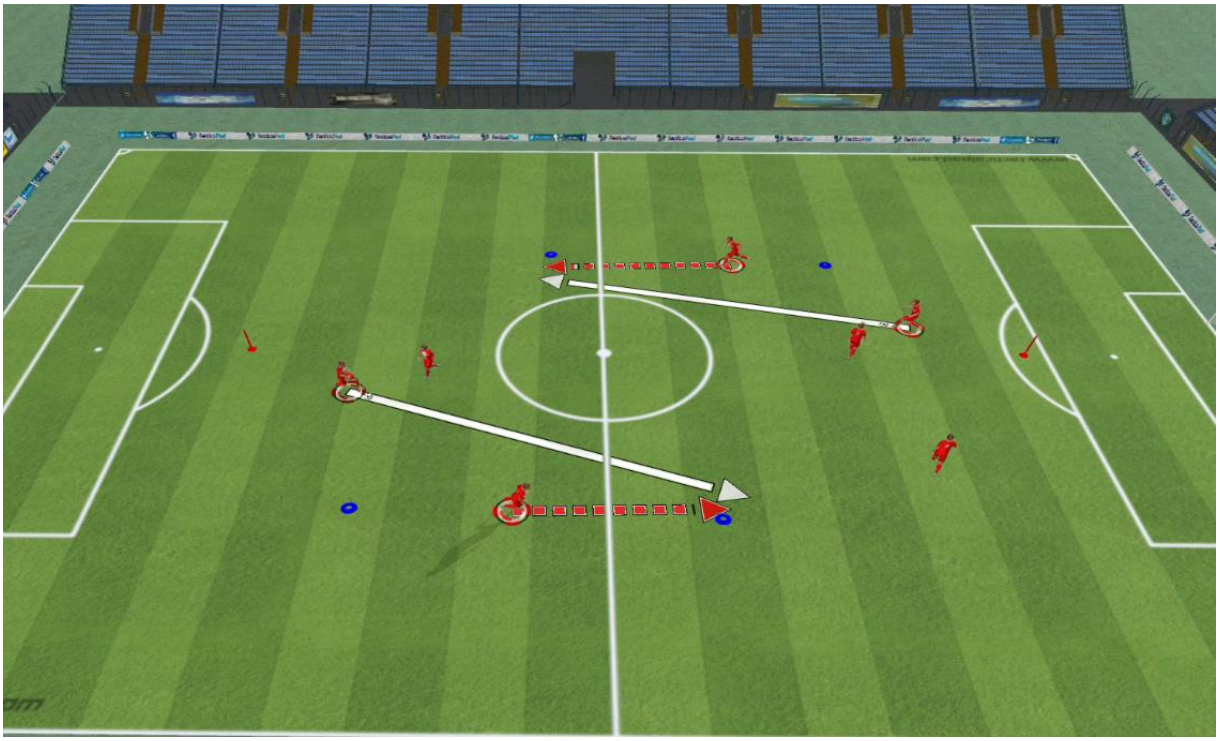


Player A makes a pass to player B. B performs an oriented control order to pass the ball in an empty space attacked by C. C must starts his run after the first contact of B with the ball and avoid being in an offside position. The pass delivered to C should respect the tempo of his run: B shall repeat several trials before the good timing (pass delivery instant / length) allowing C to receive the ball in the future zone he will reach/intercept the ball. Throughout the exercises, C can provide feedback to B (I have to change my run direction/speed…). This type of exercise familiarizes B with this situation and provides him confidence when performing such skill. A second stage would be to perform such passes under higher pressure.

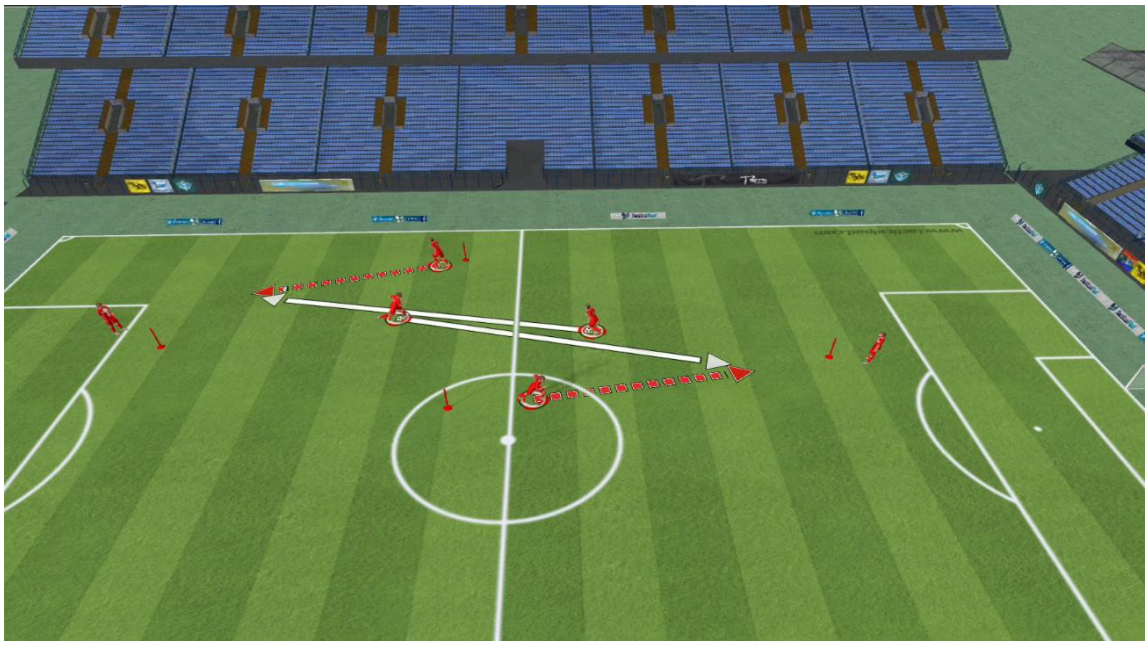
Such situations seem easy, but I have noticed that even professional players experience difficulties during such exercises. Repeating such simple situations as observed in (American) football is therefore worthy to implement for soccer. Repeating such passes would improve the timing/accuracy of players in a way similar to pianists improving his tempo when repeating scales.

Here are other technical situations that can be used during the warm-up and that should promote passes in the run/future rather than in the feet. This often only required adding a small modification to a pre-existing exercise. A quasi-infinite number of situations can be designed: what is important is to think a bit differently and integrate this idea of playing in the future as often as possible.

The following exercises are classical circuits of passes where I have integrated passes in the future. In the first exercises, the receiver starts from the blue cone and intercept the ball at the next blue cone. The search for the correct passer/receiver should be emphasized. This exercise shall not stop because of bad execution. Making players aware of the quality of their passes: repeating and on-line correcting of this skill should ultimately allow significant improvements.



This second example is also a circuit where passes in empty spaces are promoted. Players change their roles across repetitions and can therefore experience different situations.



9.5 Training ‘passes in the future’: perspectives

I have intentionally chosen to present a restricted number of training exercises because each coach can design his own exercises following his own ideas and philosophy. If the rationale I have developed sounds relevant for coaches, they could easily adjust their training protocols by integrating this idea of ‘playing in the future’.

I am convinced that this notion of playing in the empty space/future will evolve and get significant interest in the next years. The offensive animation of teams is limited to combined movements of 2 to 4 players, which is too low for teams of 11 players.

Therefore, new types of (more complex?) offensive animations should appear. Increased use of technological tools and growth of technical staffs should allow better analyses and more specific work during training sessions.

10 Conclusion

Soccer is an ever-changing, complex sport. Although game rules remained quasi unchanged over the past decades, game intensity increased and playing styles/strategies emerged. Technological tools also growingly influence game evolution as it allows fine analysis of teams' games and provide observation/analysis/feedback tools that can significant matches/training preparation.

The complexity of soccer is based on several dimensions: tactical coordination, physical condition, individual technique, mental aspects… The control of such dimensions is very demanding and requires continuous monitoring/training/strategic analysis and passion for soccer. The combination of such dimensions makes soccer the most appreciated and practiced sport in the world.

The cognitive and motor aspects in particular play a great role at both individual and team levels. The ability of players to generate fast and efficient decisions is crucial to the success of the team. Reading the game, perceiving empty spaces, reading teammates and opponents' movements, anticipating…are all cognitive skills that directly impact performance on the pitch.

At the individual level, players with good cognitive skills are more efficient and rapid in decision-making and implement creative solutions that help the team performance.

At the team level, cognitive 'coordination' is of great importance. Players must develop mutual understanding with their teammates through efficient communication skills and actions coordination. The cognitive abilities facilitate the design of complex game schemes, favor strategic synergies and allow players to be instinctively connected to their teammate on the pitch. Cognitive skills are also important for the management of emotions and pressure/stress. Players should maintain optimal concentration levels and nerve, take rational decisions and stay focused on their goals even under higher pressure.

In summary, the cognitive dimension is of great importance in soccer. It is associated with decision making, tactical creativity, inter-players coordination and management of stressful situations. Staff who emphasize the training of cognitive skills stay one step ahead: because players are more aware of the game demands, teams should be more flexible and creative on the pitch. Huge rooms for improvements exist in this area. The ultimate goal would be to make players acting (and not only reacting) on the game. This requires high cognitive skills (like anticipation) that should be trained appropriately.

11 Acknowledgments

My first acknowledgments go to the FIGC. As a Swiss coach, I was always curious and eager to discover another soccer culture. I am therefore grateful for the opportunity to complete my training as a professional coach at FIGC. I am particularly grateful for the expertise I have benefited from FIGC and am honored to have been part of your prestigious institution. I am also grateful for the quality of courses, and beyond that, the quality of exchanges I have experienced with the other UEFA PRO participants.

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12 References

Julien Clément, « Le rugby de Samoa : les techniques du corps entre "Fa'Asamoa" et mondialisation du sport », Thèse de doctorat de l'université d'Aix-Marseille 1 (2009)

Hicheur, H., Chauvin, A., Cavin, V., Fuchslocher, J., Tschopp, M., Taube, W., Augmented-Feedback Training Improves Cognitive Motor Performance of Soccer Players, Medicine & Science in Sports & Exercise, 52(1),141-152, (2020)

Hicheur, H., Chauvin, A., Chassot, S., Cheneviere, X., Taube, W., Effects of age on the soccer-specific cognitive-motor performance of elite young soccer players: Comparison between objective measurements and coaches' evaluation., PLoS ONE, 12(9): e0185460, 1-20 (2017)

Bertrand Théraulaz et Ralph Hippolyte, La bible des préférences motrices ActionTypes, Editions Amphora, 2021