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## ORIGINAL

# DECISION MAKING AND SKILL DEVELOPMENT IN YOUTH FOOTBALL PLAYERS

## EVOLUCIÓN DE LA TOMA DE DECISIONES Y LA HABILIDAD TÉCNICA EN FÚTBOL

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### ABSTRACT

This paper presents how decision-making and skills are developed in high level of expertise players from 6-7 to 13-14 years. The framework is based on the dynamical systems and teaching games for understanding approaches. Participants were 57 first team players of each age (n = 13 to 16) of Albacete Balompié: U-8, U-10, U-12 and U-14. The Game Performance Assessment Tool (GPET) was the instrument used for assessment, which measures decision-making and execution from an ecological view in relation to tactical principles

(Bayer, 1992), comparing the game situation with the decision applied. The results are based on inferential and correlation analysis. The evolution of knowledge evolves attack to defensive. We have found significant differences in variables between the four age categories studied. These differences have been shown in attack: the progress toward goal tactical principle and shake off; on defence: marking and cover (off-ball defenders).

**KEY WORDS:** Sport, dynamic systems, game performance, decision making, tactical awareness, tactical principles.

## **RESUMEN**

Este artículo presenta como se desarrolla la toma de decisiones y la habilidad técnica en jugadores con alto nivel de pericia desde los 6-7 a 13-14 años. El marco teórico está basado en la perspectiva de los sistemas dinámicos y la enseñanza comprensiva de los deportes. Se tomó como muestra a 57 jugadores del primer equipo de cada categoría de edad del Albacete Balompié: prebenjamín, benjamín, alevín e infantil. El instrumento usado fue la Herramienta de Evaluación del Rendimiento de Juego (HERJ), que mide la toma de decisiones y la ejecución, incluyendo el análisis ecológico atendiendo a principios tácticos (Bayer, 1992), comparando la situación en el juego con la decisión aplicada. Los resultados se basan en el análisis inferencial y correlacional. La evolución del rendimiento de juego se orienta desde el ataque hasta la defensa. Se han encontrado diferencias significativas en las variables entre las cuatro categorías de formación estudiadas, especialmente en el principio táctico de progresar hacia la portería contraria y en el desmarque, así como en el marcaje y la ayuda en defensa.

**PALABRAS CLAVE:** Deporte, sistemas dinámicos, rendimiento de juego, toma de decisiones, estrategia, principios tácticos.

## **1. INTRODUCTION**

According to French and McPherson (2004), there is a demand for studies that analyse changes in the basic knowledge, decision making and motor patterns in youth. Most of the studies undertaken are concerned with the performance of adults (French and McPherson, 2004). Regarding the study of decision making, it cannot be considered a normative and lineal process (Newell, Liu and Mayer-Kress, 2003), as both decision making and the aspects that influence it (previous knowledge, skill level, etc.) interact with the different constraint factors of each sport modality (Araújo, Davids and Hristovski, 2006). We will now present an example with the sport that this study deals with, football. The fact that a pass is successful depends not only on the passer's skill, but also their capacity to withstand the psychological pressure of the match or the adequate state of the pitch. Besides individual and contextual factors, those factors directly related to the task at hand are relevant. In this regard, each decision context is different in itself, and sports of an open nature are subject to constant changes that modify the problems outlined. If we take the previous example into account, a one-on-

one situation is completely different when it happens near the individual's own goal than when it is next to the opponent's goal. Pressure conditions, the space available to play the ball, the number of players the ball may be passed to... all those elements will vary from one situation to another.

This focus of decision making training is the one based on the theoretical principles of ecology dynamics, which is based on the manipulation of the constraint factors of the task, the individual and the context (Araújo, Davids, Chow and Passos, 2009). In this regard, research studies have been published which deal with dynamic systems and decision making in team sports, studies that have confirmed the constraint factors of tasks as a key point for the development of tactical-technical performance (Correia, Araújo, Duarte, Travassos, Passos y Davids, 2012; Correia, Araújo, Vilar y Davids, 2013; Travassos, Duarte, Vilar, Davids y Araújo, 2012).. When researching football, there is a tendency for researchers to focus on the study of expert players (González-Víllora, 2010; Morris, 2000), which leaves a gap regarding the learning processes of young players. In the last years there has been an increase in the interest towards that kind of research, the process of learning-teaching in young players from the tactical perspective, and proof of that are the following studies.

De la Vega (2002) studied the development of the tactical understanding of the game and metacognition in football players 8 to 14 years old. Amongst the youngest of them (8-10 years) it was proven that, as a result of egocentricity, children are forced to focus on the tactical principles of scoring goals in attack and avoid goals in defence. The interest in cooperation in attack situations did not come up as a consequence of the evolution of the game, but as a way of sharing happiness with friends. In defence, interest was quantitative, the need to have more players with the objective of achieving possession of the ball. In later stages (10-12 years) importance was given to maintaining the possession of the ball, but without trying to generate imbalances that allow to score goals. At the defensive level, it was only centred on the player with the ball. With time the notion of losing one's defender was introduced, but it was not associated to depth and progression, and therefore lacked the objective of obtaining an advantage in relation to the opponents. In defence appeared the first considerations as to why attackers overcame defenders, and that was translated into the understanding of notions such as covers and switches. In the last studied phase (12-14 years), speed was linked to the precision when creating imbalances, and then the notions of match rhythm and attack space started to gain importance. The importance of the central lane was already clear regarding wingers in relation to the distribution of the game and the search for imbalances, as vertical and horizontal plays were integrated. In defence, they started to understand as well that it is not important that opponents have a low possession of the ball, but whether they did or did not achieve depth in the game. For that reason the rival's features started to be studied in order to play more effectively.

In the under 8 years category, there are some very interesting studies that must be taken into account in relation to the coach's decision making. Lapresa, Arana

and Garzón (2006) and Lapresa, Arana, Garzón, Egüén and Amatria (2010) exposed the need to adapt the competition in the initiation to football. Competence in football skills for this age showed deficiencies in the adjustment between game characteristics and actual possibilities. Players had difficulties in 5 vs. 5 matches, since they did not provide their game depth and amplitude, due to the lack of changes in orientation. These authors suggested starting the search for a football modality more adapted to children, taking as reference 3 vs. 3.

In the next category, under 10s, Serra-Olivares, González-Villora and García-López (2011) analysed two modified matches of 3 vs. 3 football, a game similar to the real thing (dimensions reduced to 32 x 22 m.), and another that exaggerated the principle of keeping ball possession (the objective was to achieve 5 passes in a 20 x 20 m. space). Although the second game presented the only tactical problem of keeping the ball, and in the first players faced different tactical problems, when the results corresponding to the success in decisions and executions were studied, the players presented better percentages in the modified game similar to the real game, a percentage which was significantly better in instances of losing one's defender.

At higher ages, 12 to 13 years old, Memmert (2010) undertook a double study with the aim of assessing the tactical situations centred on two game tests for young talents (12-13 years) which were found amongst the best young players in Germany, as they were chosen from seven performance schools in that country: 1) Game test trying to benefit from the spaces between defenders in 2+2 vs. 3, in 8 x 7 m: the objective is to take advantage of the openings left by defenders, which can be found in a line in the middle of the space, so that the attackers, who are placed two on each side, manage the tactical tasks that depend on the (individual) exploitation of the free spaces in order to make a pass from one side to the other; 2) Game test in a "coming up field and facing another direction" situation in 3 vs. 3, in 9 x 9 m: based on tactical tasks that depend on the optimum position in the pitch at the moment in which the pass decision is taken. Results showed that both game tests may be used to measure the specific creativity in football and the in-game intelligence of young players. The results regarding divergent tactical thinking proved that change processes are very different in the football players of the sample.

In another study, Blomqvist, Vääntinen and Luhtanen (2005) proposed assessing for secondary education students ( $n = 12$ , 14-15 years) the way in which the understanding of the game corresponds to the levels of decision making and the actual game skills execution. To do that, the subjects were assessed by means of a video test with three types of modified matches of 3 vs. 3 football (ball keeping, advancing towards the opponent's goal and achieving the objective). Results showed that students already had a basic notion both of offensive and defensive game situations. It was also concluded that those players who had a greater game understanding possessed also a better result in game skills.

These studies have proven a great heterogeneity regarding the knowledge, understanding and execution of skills in the game, resulting in several tactical possibilities taking as starting point different methodologies and assessment

instruments (Blomqvist et al., 2005; French and McPherson, 2004). Therefore, it is more important to look at the way in which each study may enlighten some facet or other of tactical-technical teaching than to find a common pattern. There is, therefore, a need for studies that examine individual differences and the interaction between physical, cognitive and emotional developments (González-Víllora, 2010). We need more studies to evaluate the way in which those mechanisms (base knowledge, cognitive processes, motor patterns) change in practice periods from childhood to adolescence (French and McPherson, 2004; McMorris, 1999), as well as longitudinal studies and the use of research designs that are ecologically valid (McMorris, 1999). Therefore, the objective of the study is to know the way in which the game performance capacity evolves for subjects with a high skill level in football, to know how they face tactical problems and thus be able to adapt the teaching-learning processes to the actual capabilities of young players.

## **2. MATERIAL AND METHODS**

### **2.1. PARTICIPANTS**

The sample included 57 male players in Albacete Balompié's youth teams, with an average age of 10,84 ( $dt=1,96$ ), all of them with a high skill level depending on each one's category. The club did a previous selection to access the different teams, and all players included in the sample belonged to each category's "A" teams, which means that they were chosen amongst the total number of players in each age group. The selection of players was done by the group of coaches in each category, who possessed second or third federative levels and a minimum of five years experience in formative categories. The selection criteria were based on the following items: effort and use of training sessions, performance in competition, technical sheets, having or having not been selected at regional or national level. Finally, the following players and categories were assessed: 14 players in the under 8 category, 13 players in the under 10 category, 14 players in the under 12 category and 16 players in the under 14 category.

Under 8 and under 10 players trained twice a week, while under 12 and under 14 players trained three times a week, and in weekends participated in competitive games, which had different characteristics depending on the category. All parents/mentors responsible for those players signed an agreement so that they could take part in the study.

### **2.2. ASSESSMENT INSTRUMENT**

The study assessed the technical-tactical capacities of young football players by means of the Game Performance Assessment Tool (GPET), after validating and checking its reliability (García-López, González-Víllora, Gutiérrez and Serra, 2013). The instrument separated the cognitive-decision making component and the performance in the execution of the specific motor skills in a real game situation of modified football games. This modification takes as starting point A-11 football, and studies the possibilities of children in relation to the number of players (under 8, 2 vs. 2; under 10, 3 vs. 3; under 12, 5 vs. 5; under 14: 7 vs. 7).

The pitch dimensions, goal areas and goals varied depending on the type of game:

- 2 vs. 2 game = space: 20 x 10 m, goal areas: 3 x 4 m, goals: 95 x 70 cm (without goalkeeper).

- 3 vs. 3 game =  $\frac{1}{4}$  A-7 football (32 x 22 m), goal areas: 5 x 9 m, goals: 140 x 105 cm (without goalkeeper).

- 5 vs. 5 game =  $\frac{3}{4}$  A-7 football (52 x 40 m), goal areas: 9 x 19 m, goals: 140 x 105 cm (without goalkeeper).

- 7 vs. 7 game = A-7 football (64 x 44 m), goal areas: 11 x 24 m, goals: 6 x 2 m (with goalkeeper).

All matches analysed had two 4-minute periods with 3 minutes of rest.

The tool analysed the way in which players responded to different contexts or tactical problems that they faced during the game. Therefore, the analysis of variables in decision making and skills execution was complemented with the adaptation to the contexts proposed by Bayer (1992): keeping ball possession (Pp1A), advancing towards the objective (Pp2A) and achieving the objective (Pp3A). What follows is an example of a player that has the possession of the ball and two unmarked team mates to whom he can pass the ball, one advanced and another backfield. According to the research done up to this moment, a pass done to any team mate unmarked would be a correct decision. This, however, does not take into account the game situation. In invasion sports, whenever there is a chance, it must be taken to advance towards the goal with the objective of getting closer to scoring a goal. Therefore, those two passing decisions do not have the same quality. This is one of the main objectives of the study, as it is not trying to measure decision making and skill in an isolated manner, but on the contrary to analyse them in relation to the tactical context in which they were originated and comparing them to the actual behaviour. The most relevant novelties of the GPET are (see table 1):

1. The modification of A-11 football according to the children's needs.
2. Game actions are contextualized by means of the application of attack principles (Bayer, 1992): Keeping ball possession (1A), advancing towards the objective (2A) and achieving the objective (3A).
3. The four game roles are assessed: attacking player with and without the ball, defending player to attacker with the ball and to attacker without the ball.
4. Technical-tactical individual elements were included that did not have a special consideration in other studies, to verify whether they are important in terms of learning, such as: fixing, blocking, tackles, clearings or interceptions.
5. Both attack and defence are assessed, in order to analyse their relationship.

**Table 1:** Game variables measured in the GPET

Game roles	Individual technical-tactical element	
	Evaluated game principles	Decision making and success in the execution are measured
Attacking player with the ball	1A: Keeping 2A: Progressing 3A: Achieving the objective	Control (only execution is measured) Pass Carrying the ball / Dribbling Shooting / Finishing
Attacking player without the ball	1A: Keeping	Losing one's defender
Defender to attacker with the ball	2A: Progressing	Fixing Marking, pursuit or basic position Defensive blocking Tackle Clearing the ball Help
Defender to attacker without the ball	-	Marking, pursuit or basic position Interception Clearing the ball
attacker with the ball	-	Helping the defender to

### 2.3. PROCEDURE

This study included the following stages:

- 1) Preparation of a theoretical framework in which to structure the study, based on dynamic systems, task constraint factors, comprehensibility teaching of sports and previous studies in this line of research.
- 2) GPET configuration: undertaking the processes of validity and reliability (García-López et al., 2013).
- 3) Data collection by means of recording matches in the four categories included in the study, using the facilities of the club, taking place in the last two months of the season (May and June), in a period of four days, one for each of the formative categories.
- 4) Data analysis by means of the viewing of the matches' sequences and the GPET's registry sheets, introducing the results in the SPSS database, preparing the statistical analysis and filling up the results report (González-Víllora, 2010).
- 5) Writing the manuscript and reviewing it.

## **2.4. DATA ANALYSIS**

The assessment of the evolution in the game performance, both in decision making and in the specific motor skill levels, was made with the SPSS 17.0 program. The statistical analysis was based on non-parametric tests according to the sample number. Regarding the nature of the game, a basic descriptive analysis was employed. To measure the relationship of the game situation principle to the game principle applied by players the Kruskal-Wallis test was used. In the analysis of the tactical principles and the technical-tactical principles between pairs of formative categories the U statistical of Mann-Whitney was used: test that compares statistically the presence of differences between averages for several independent samples. Finally, a correlational analysis was done between the decision making and the execution of skills in each technical-tactical element by means of the Rho statistical of Spearman. This analysis was done to learn whether there existed or not correlations between decision making and the success in the execution in each of the technical-tactical elements studied.

## **3. RESULTS**

### **3.1. NATURE OF THE GAME**

The following results are the differences and similarities found between the categories of the study. Adding up the four categories, a total of 2217 decision making units (UTD) were analysed. A UTD is the number of technical-tactical decisions made by an attacking player in each play of the game; in defence, however, each UTD is the number of technical-tactical actions of the opposing player with which the defender must interact. Therefore, it is assumed that all actions by the attacking players must provoke a reaction on the part of the defender.

These UTD are divided into the three offensive tactical principles for the different game situations. In the first principle, keeping the possession of the ball, 482 UTD were analysed (21.74% of the total), of which 87.75% were adequately resolved. In the second attacking principle, advancing towards the goal, most of the UTD were analysed, which added up number 1626 (73.34%), of which 88.13% were adequately resolved. In the third principle, achieving the objective, a lesser number of UTD were analysed, as it is difficult to reach that situation. The total was 109 UTD (4.91%), of which 84.40% were adequately resolved.

If the results are analysed by each category in a specific manner, the percentages regarding attacking principles vary. As we advance further up categories, the situation principle of achieving the objective is reduced (from 6.67% in under 8s to 2.84% in under 14s), so that it is harder to get to the opponent's goal in a suitable situation to score a goal. This result may be conditioned itself by the number of players and pitch dimensions in each category (from 2 vs. 2 in under 8s to 7 vs. 7 in under 14s). In relation to the two remaining offensive principles, if the results for the under 8 category are omitted



(2 vs. 2 game), and we focus on the data from the under 10 to the under 14 categories, the first attacking principle (keeping the ball) gains an increased importance (goes up from 7.6% in under 10 and 25.65% in under 12 to 33.09% in under 14), probably due to the greater difficulty of getting to the opponent's goal owing to the increase in the quality of the defence, the greater game space and the increasing number of players. The situations on the second principle, advancing towards the objective, are reduced, but are still the situations most often repeated (for instance, in the under 14 category: 64.07%).

### 3.2. COMPARISON OF THE SOLUTIONS PROVIDED BY PLAYERS IN EACH CATEGORY

#### ***Relationship: Situation principle/Application principle***

An analysis was made on whether those results included significant differences in the capacity to adapt to the situation principle by means of the Kruskal-Wallis statistical (table 2).

**Table 2:** Comparison of measurements in attacking principles: Kruskal-Wallis test

	Pp Sit Apl 1A1A	Pp Sit Apl 1ANo	Pp Sit Apl 2A2A	Pp Sit Apl 2ANo	Pp Sit Apl 3A3A	Pp Sit Apl 1A	Pp Sit Apl 2A	Pp Sit Apl 3A	Pp Sit-Apl Total	Pp Sit-Apl Total Suc
Chi-squar e	5.52	9.50	37.72	9.72	3.56	25.03	20.88	7.15	39.45	13.16
Next asymp	.137	.023(*)	.000(**)	.021(*)	.312	.000(**)	.000(**)	.067	.000(**)	.004(*)

*\*\*p<.01, \*p<.05.* Pp= principle. Sit= situation. Apl= application. 1A= 1st principle: keeping. 2A= 2nd principle: advancing. 3A= 3rd principle: scoring. Suc= success.

As can be seen on table 2, there are significant differences in the second principle (advancing), both for correct and incorrect decisions. Also in the situation principles of keeping and advancing, as well as in the total relationships of the principles of situation and application with the making of adequate decisions and the success in the executions.

#### ***Analysis of the tactical principles and the technical-tactical elements between pairs of formative categories***

What follows is the analysis of the game performance by pairs of categories, to learn in which age ranges those differences are observed (Tables 3 and 4).

**Table 3:** Significant differences found between each pair of categories (Mann Whitney's U): tactical principles

Pair of analysed categories	Tactical principles	Mann Whitney's U	
		Next asymptotic (bilateral)	Next exact [2*(Next unilateral)]
Under 8 with Under 10	Principle Sit Apl 2A 2A	.015	.014
	Principle Sit 1A	.000	.000
Under 8 with Under 12	Principle Sit 2A	.000	.000
	Principle Sit Apl Tot Td	.027	.025
	Principle Sit Apl Tot Ex	.012	.094
Under 8 with Under 14	Principle Sit Apl 2A 2A	.001	.001
	Principle Sit Apl Tot Td	.002	.002
Under 10 with Under 12	Principle Sit Apl Tot Ex	.016	.114
	Principle Sit Apl 2A 2A	.000	.000
	Principle Sit Apl 2A No	.010	.101
Under 10 with Under 14	Principle Sit Apl Tot Td	.000	.000
	Principle Sit Apl 1A No	.004	.011
	Principle Sit Apl 2A 2A	.015	.014
	Principle Sit 1A	.000	.000
	Principle Sit 2A	.000	.000
Under 10 with Under 14	Principle Sit Apl Tot Td	.044	.043
	Principle Sit Apl 1A 1A	.006	.022
	Principle Sit Apl 2A 2A	.000	.000
	Principle Sit Apl 2A No	.001	.013
	Principle Sit 1A	.000	.000
	Principle Sit 2A	.001	.000
	Principle Sit 3A	.030	.032
Under 12 with Under 14	Principle Sit Apl Tot Td	.000	.000
	Principle Sit Apl Tot Ex	.008	.083
	Principle Sit Apl 1A 1A	.034	.034
	Principle Sit Apl 2A 2A	.000	.000
	Principle Sit Apl 2A No	.004	.047
Under 12 with Under 14	Principle Sit Apl Tot Td	.000	.000
	Principle Sit Apl Tot Ex	.010	.101

Differences between categories: asymptotic significance (bilateral) is  $p < .05$

**Table 4:** Significant differences found between each pair of categories (Mann Whitney's U): technical-tactical elements

Pair of analysed categories	Technical-tactical elements	Mann Whitney's U		
		Next asymptotic exact (bilateral)	Next [2*(Next	
Under 8 with Under 10	Shooting Td Total	.044	.052	
	Shooting Ex Total	.045	.052	
	Carrying the ball Ex 2A	.004	.003	
	Carrying the ball Ex Total	.014	.014	
	Losing one's defender Td 2A	.002	.001	
	Losing one's defender Ex 2A	.012	.011	
	Losing one's defender Td Total	.003	.002	
	Losing one's defender Ex Total	.029	.029	
	Marking DA_with_b Td	.002	.001	
	Marking DA_without_b Td	.000	.000	
	Marking DA_without_b Ex	.049	.048	
	Under 8 with Under 12	Passing Td Total	.013	.039
		Shooting Td Total	.001	.001
Carrying the ball Ex 2A		.029	.035	
Blocking DA_with_b Ex		.018	.022	
Under 8 with Under 14	Passing Td 2A	.049	.172	
	Passing Td Total	.023	.058	
	Shooting Td Total	.001	.001	
	Carrying the ball Td 1A	.016	.024	
	Carrying the ball Ex 1A	.039	.073	
	Marking DA_with_b Td	.001	.001	
	Marking DA_with_b Ex	.014	.014	
	Marking DA_without_b Ex	.015	.013	
Marking JDaAsB Ex	.011	.009		

Under 10	Shooting Ex Ppi 3A	.007	.009
with	Shooting Ex Total	.047	.069
Under 12	Losing one's defender Td 1A	.025	.051
	Losing one's defender Td 2A	.000	.000
	Losing one's defender Ex 1A	.015	.026
	Losing one's defender Ex 2A	.001	.000
	Losing one's defender Td Total	.000	.000
	Losing one's defender Ex Total	.001	.000
	Tackle DA_with_b Ex	.047	.056
	Interception DA_without_b Td	.012	.011
Under 10	Losing one's defender Td 2A	.032	.040
with	Losing one's defender Ex 2A	.011	.010
Under 14	Losing one's defender Td Total	.036	.040
	Marking DA_with_b Td	.047	.115
	Tackle DA_with_b Ex	.027	.030
	Interception	.041	.040
	DA_without_b Td		
Under 12	Carrying the ball Td 1A	.028	.048
with	Losing one's defender Td 1A	.021	.046
Under 14	Losing one's defender Ex 1A	.010	.020
	Losing one's defender Td Total	.034	.034
	Losing one's defender Ex Total	.022	.022
	Help DA_without_b Td	.016	.018

Differences between categories: asymptotic significance (bilateral) is  $p < .05$

Note: DA\_with\_b: Defender to attacker with the ball

DA\_without\_b: Defender to attacker without the ball

If we pay attention to tactical principles, in the results we find significant differences in favour of the highest category ( $p < .05$ ), differences which appear more often in all the pairs of categories analysed in the second attacking principle (advancing towards the opponent's goal) than in the other two evaluated tactical principles (keeping the ball and achieving the objective).

If we analyse offensive technical-tactical elements, losing one's defender is the one on which we find the most significant differences between pairs of categories, both in decision making and in execution (under 8-under 10; under 10-under 12; under 10-under 14, only decision making; under 12-under 14). These significant differences in losing one's defender are evident in the second tactical principle (advancing), as it can be seen both for decision making and success in execution in three pairs of categories: under 8-under 10, under 10- under 12 and under 10-under 14. In the first principle (keeping) we find significant differences in losing one's defender, decision making and executions in two pairs of categories: under 10-under 12 and under 12-under 14. But this requires a more in-depth analysis, as in the second principle significant differences occur in the categories with less experience, while the differences in the first principle occur in the categories with more experience. Therefore, progression occurs in the first stages of training on the advance towards the opponent's goal and in the under 12 and under 14 categories on the principle of keeping the ball at play. The most active

defence in this last learning stage has an influence on that evolution, as in the uppermost categories the team that defends blocks in a noticeable manner the progression towards the goal.

Regarding the attacking player with the ball, there are several technical-tactical elements with significant differences. Thus, in carrying the ball there are significant differences in almost all pairs of categories, but more so regarding execution than decision making. Passing is the element with the least significant differences in this role, as it only occurs in two pairs of categories (under 8-under 12: total decision making; and under 8-under 14: total decision making and the second principle). In shooting we find significant differences especially in total decision making in the under 8 category in relation to the rest (under 10, under 12 and under 14), whereas in relation to the success of executions we find significant differences in two pairs of categories (under 8-under 10: total execution; under 10-under 12: total execution and third principle).

Regarding defence, significant differences appear with less frequency than in attack. Although there are exceptions, such as the technical-tactical element of marking, both to the player without the ball and to the player with the ball, and more often in decision making than execution. Other defensive elements that present differences are help (Defender to attacker without the ball) and blocking (Defender to attacker with the ball).

### ***Correlational analysis between decision making and skill execution in each technical-tactical element***

Table 5 shows the variables in which significant differences have been found with Spearman's Rho test in the five analysed groupings: total sample and the four categories (under 8, under 10, under 12 and under 14).

**Table 5:** Significant differences found in the studied variables (Spearman's Rho):  
technical- tactical elements

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1. In all the players in the sample we found a significant correlation between decision making and success in execution in:  
Carrying the ball in the first principle (keeping),  $\rho = .735$ ,  $p = .000$ .  
Losing one's defender in the first principle (keeping),  $\rho = .829$ ,  $p = .000$ .
  2. In the players in the under 8 category we found significant correlations between decision making and success in execution in:  
Passing in the second principle (advancing),  $\rho = .617$ ,  $p = .019$   
Losing one's defender both in the first tactical principle (keeping),  $\rho = .976$ ,  $p = .033$ ; and in the second tactical principle (advancing),  $\rho = .827$ ,  $p = .000$ .  
Marking in defence to attacker with the ball,  $\rho = .842$ ,  $p = .000$ .  
Help in the defender to attacker with the ball,  $\rho = .851$ ,  $p = .000$ .  
Marking in defence to attacker without the ball,  $\rho = .763$ ,  $p = .001$ .
  3. In players in the under 12 category we found significant correlations between decision making and success in execution in:  
Carrying the ball in the first principle (keeping),  $\rho = .859$ ,  $p = .006$ .  
Losing one's defender in the first principle (keeping),  $\rho = .719$ ,  $p =$

.004.

4. In players in the under 14 category we found a significant correlation between decision making and success in execution in losing one's defender in the first tactical principle (keeping),  $p= 1.000$ ,  $p= .000$ .

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In attack, results show that losing one's defender is the technical-tactical element with the highest number of positive correlations, especially in the first principle (keeping). We also found that the principle with the most positive correlations is the first principle, whereas for the second principle (advancing towards the objective), passing gains relevance in the effects of an adequate decision making over success in the execution. Finally, shooting in the third principle only has a positive correlation between decision making and execution in under 10s. It is important to point out that in technical-tactical elements in defence we did not find significant differences, with the exception of the under 8 category, where we find three elements: marking and help in the defender to an attacker with the ball and marking in the defender to an attacker without the ball.

If these data are considered from a global perspective, the groups with more game experience possess less variables that correlate. That might be due to two reasons. Firstly, the characteristics of the game and the number of players per game, from 2 vs. 2 to 7 vs. 7. The higher the number of players per team, the lower the direct participation with the stimulus. Secondly, when advancing upwards through the categories, we should take into account, besides the basic principles of attack, other more specific principles, such as how near or far to the ball the player is. The nearer he is, the more pressure he will receive from the opponent. We also start to find specialization in game positions. Thirdly, when you go up categories the game speed is higher, which requires higher precision in complex situations. All of this may have an influence on players' assessments and the criteria to detect sports talents.

## 5. DISCUSSION AND CONCLUSIONS

The objectives of the study are to find out how performance in the game evolves in subjects between 6-7 and 13-14 years old with a high skill level, and thus enhance training processes. Roughly, results show that the development of decision making cannot be understood as a normative and lineal process, as there will always be certain modifications regarding participants (Newell et al., 2003), due to the fact that this is an open sport in a dynamic and unpredictable context. For instance, the possibilities to pass the ball change constantly depending on the relations established between individuals and the game context (Fajen, Riley and Turvey, 2009), or in the present study, the comparison between the game situation and tactical principle applied in each case. Therefore, the decision making process reflects the execution of a solution that fits each individual situation in order to achieve the objective.

Solutions come up as a result of exploring the environment and detecting certain possibilities for action (*affordances*), taking into account the abilities that those individuals possess (Araújo et al., 2006; Fajen et al., 2009). In invasion sports and especially football, these dimensions may change in a few seconds. Therefore, in order to design representative practical tasks (*representative practice task design*) one of the key points is the reciprocal relationship between

individuals and environment (Gibson, 1986). According to Davids, Williams, Button and Court (2001) movements are executed depending on the information the subjects receive from the environment (*information-movement coupling's*), concretely the information that the subject is able to analyse, called functional information. Therefore, young players should be taught progressively which elements are essential in the game in each situation, that is, they must be trained in selective attention. In the context of dynamic systems, some research works into team sports have been recently published (Correia, Araújo, Duarte et al., 2012; Correia, Araújo, Vilar et al., 2013; Travassos et al., 2012) that emphasize task constraints and decision making in relation to group behaviours in a sporting context.

On the contrary, there are some studies that do not follow this perspective, such as: Salinero, González-Millán, Ruíz-Vicente, Abián Vicén, García-Aparicio, Rodríguez-Cabrero and Cruz (2013), who evaluated 256 10 to 17 years old football players with tests such as: 1) Speed and technique carrying the ball and 2) Speed and precision shooting to goal. These two tests were undertaken in analytical and isolated situations that did not have a direct relation with the specific context of the game. In the carrying the ball test there were no significant differences between age groups, whereas in the shooting precision test, in the time they employed to do the test, significant differences were found only between the two extreme groups (10-11 and 16-17 years), and the oldest kids were the fastest. The youngest group obtained a higher precision and presented significant differences in relation to the remaining groups. Therefore, very few significant differences were found, and those that were found occurred in those age groups that were set apart with 6 years of difference. These results contradict those exposed in this study, as we found significant differences in player groups with a difference of 2 to 4 years. The cause for this divergence seems evident, as in studies with analytical situations no importance is given to the synergies derived from the context and the relationship between players, whereas in the studies in which the indicators of dynamic systems are taken into account the analysis includes the tactical dimension and the complexity of the game.

On the other hand, the learning and decision making processes are affected by different variables that are inter-related. One of them is the egocentricity typical of children (Bayer, 1992; De la Vega, 2002). This is reflected in the carrying the ball technical-tactical element, which includes both handling the ball and dribbling, as in the game performance analysis we find in this action more significant differences between the first analysed categories, under 8 and under 10, than in the following, under 12 and under 14. There is, thus, a greater evolution in carrying/dribbling in the first categories, where efficiency is lower, and it is in the execution of carrying/dribbling where these differences are more obvious compared to decision making. In attack, significant differences are found in the first tactical principle: keeping the ball. This confirms the analysis of the frequency of the execution of technical-tactical elements presented in other studies (González-Víllora, García-López, Gutiérrez-Díaz and Pastor-Vicedo, 2012; González-Víllora, García-López, Pastor-Vicedo and Contreras-Jordán, 2011). These studies proved the abuse in carrying the ball and dribbling in the under 8 and under 10 categories. In these categories players are individualistic, as they prefer to carry the ball or dribble and not so much pass the ball to an unmarked team mate. In higher categories, under 12 and under 14, more passes

are done, and instances of carrying the ball go down (González-Víllora, García-López, Contreras-Jordán and Gutiérrez-Díaz, 2010; González-Víllora, García-López, Gutiérrez-Díaz and Pastor-Vicedo, 2013). Therefore, in each formative stage “some aspects of performance may constraint the development of other specific elements in the progression towards excellence” (Rink, French and Graham, 1996, p. 498). Coaches in the first categories must, therefore, focus the attention of their pupils on those other possibilities that the game with the ball offers. They would, thus, favour the perception of game clues (Kirk and MacPhail, 2002), such as a team mate losing his defender or passing lines.

As players move up categories, they are less individualistic (Bayer, 1992; De la Vega, 2002), as the instances of team mates losing their defenders acquire relevance by their quantity: amount of instances, and quality: success in decision making and execution (González-Víllora, 2010), something that can be seen both in an inferential and a correlational analysis, as presented in this study. As a consequence, losing one's defender is an essential evolution for these players, as it is the element where more significant differences are found in game performance between categories. Regarding defence, a more effective application of defence to the game without the ball increases significantly in the under 12 and under 14 categories, so that learning defensive help becomes a key point in the collaboration between defenders. The defensive stage of the game is understood in the first categories as simply a physical frontal opposition to the attacker with the ball (De la Vega, 2002), and the pressure on attackers without the ball is soft or non-existent, which can be appreciated in the results of marking and defensive help from the defender to the attacker without the ball.

The results show that technical-tactical actions have already been learnt at the end of the under 12 category (12 years), as when this stage is finished players have a good knowledge of individual abilities (González-Víllora, García-López, Contreras-Jordán et al., 2010). The evolution of the game performance due to the significant differences found in this study is evident in elements such as carrying the ball, passing, losing one's defender or marking. That is not to say that individual actions should not be trained anymore, as they need a constant perfecting aimed at achieving better performances. Although learning techniques must possess some minimum characteristics of sport representation, that does not mean tactical elements should be separated from the technical ones or vice versa; on the contrary, technical-tactical elements must be practised in one single ecological dimension. This is something that is reflected in the development of the performance from the under 12 to the under 14 categories, as the evolution is clear in instances of losing one's defender and defensive help, which reflect that progression is focused on group technical-tactical elements.

Specific creativity and game intelligence are key for the adequate development of young players (Memmert, 2010). In this regard, González-Víllora, García-López, Contreras-Jordán et al. (2010) stated that performance in offensive instances is reached at a lower age than defensive performance, as the levels of adaptation in decision making and efficiency in motor execution are higher. This ease to achieve offensive skills rather than defensive was already exposed in the study of Blomqvist et al. (2005). To execute offensive skills intentional cognitive processes are required which must be undertaken before the action, and it is a very abstract knowledge that is very hard to coordinate amongst many players. For instance, a player can intentionally lose his defender successfully by freeing



the player without the ball of the opponent's mark, but if the player with the ball does not perceive that action or if, having perceived it, he is unable to do a successful pass, cooperative performance will be at a minimum. An adequate individual defence, on the other hand, requires only a specific knowledge focused on the specific behaviours of direct opponents (marking plus tackle, blocking, clearing the ball or interception). Defensive cooperation, however, is made easier by means of learning and training defensive help, a technical-tactical element in which significant differences have been found in the role of defender to attacker without the ball between the under 10 and under 12 categories and with the under 14 category. The present study confirms this idea, since the evolution of offensive technical-tactical elements, such as passing or losing one's defender, have more relevance in the development of young players than defensive elements, although some of those also advance in a significant manner, such as marking or help. This may be due to the fact that the majority of football training programs give priority to attack over defence (González-Víllora, 2009). Coaches must take into account that defensive learning may be an obstacle to a later contextual learning of attack. Therefore, it is necessary that the coaches know that it is probable that young players will learn attack elements before defence elements, so that, depending on the learning process and the competition, they may decide when to introduce them.

To go a bit more in-depth into this, in the first stages of attack learning the objective is to score as fast as possible and to perform a direct game. This may be observed in the fact that the percentage of frequency of the principle of achieving the objective goes from 6.67% in under 8s to 2.84% in under 14s. Later on, players elaborate a game better organized regarding depth and amplitude, using in a more adequate manner the three tactical principles to be applied in relation to the game situation. In defence, the possibility of applying a greater or lesser defensive pressure on the attacking team has a great influence depending on the type of game (space and number of players), whether it's 2, 3, 5 or 7-football, and the spatial-temporal use that is employed. In this sense, Lapresa et al. (2010) confirmed the great difficulty that under 8 players had to adapt their behaviours to the 5-football game tactic, especially in terms of depth and amplitude in the use of space, so that they reclaimed a 3 vs. 3 game in this category. Lapresa et al. (2006) proposed for their part 9-football as an intermediate game between 7-football and 11-football, on account of the use of the game space, which seems to make sense, as it implies a better adaptation in the progression to a higher difficulty.

Therefore, under 12 and under 14 players choose better when to keep the ball and when to advance toward the opponent's goal (see table 3), as a consequence of which in the game there is a better interaction between the horizontal and vertical axis or regarding the variation of direct and indirect game taking into account defensive movements. Defence is done with ever greater precision, which is reflected in the fact that both marking and help of defenders to attackers without the ball improves in a significant manner.

For players that are being trained it is essential to know which technical-tactical element to choose in each game situation (do a pass to a team mate or carry the ball to advance depending on the opponents' positioning), how to do it and when to do it. According to the results of the study, optimum instances of losing one's defender are essential in the game's offensive phase. In the defensive phase, on the other hand, markings with and without the ball are more important, and once the under 12 category is reached, the use of help acquires more importance. Therefore, the instrument of assessment and the results exposed in this research may be used to enhance the planning of learning-teaching in football. They may also be useful to group players of the same category in skill levels or to detect young talents. In this sense, Gutiérrez-Díaz, González-Víllora, García-López and Mitchell (2011) exposed the differences found by means of the same methodology (GPET) in decision making and execution skills amongst young football players with a high skill level and primary education students from 6-7 to 13-14 years of age. Their conclusions show that football players know and perform technical-tactical elements two years before a schooled pupil that has not received any specific training on the competences related to invasion sports.

Another of the objectives of the study is to know whether there is an age range in which there is a "key" moment or a "more efficient" moment regarding sport development. The results show significant differences between all pairs of categories, but if we had to choose a period where there is an evident jump in the game performance, that would be at the end of the under 12 category (comparing the results to those of the under 14 category). Especially in the efficiency of decision making, both in the relationship of the game situation to the tactical principle applied (keeping the ball and advancing towards the opponent's goal) and in some offensive technical-tactical elements such as carrying the ball-dribbling in the principle of keeping the ball, losing one's defender in the total sample; in defence in the help of the defender in relation to the attacker without the ball. In execution, on the other hand, there are significant differences in the total sample of the situation principle in contrast to the application principle, as well as in losing one's defender in the principle of keeping the ball and the total sample.

The integration of scientific contributions in the pedagogical field should be observed in football pitches with players in the formative stages. This study provides useful info for coaches regarding aspects such as overcoming egocentricity in the first stages, the alternation in the teaching of attack and defence, the increase in the number of players in the reference competitive game or the use of the GPET as a means of helping the planning and assessment of the footballer's talent. Since this study is based on free attack and individual defence, we need more studies that analyse other types of attack and defence, such as zone defences, which are very common in football, and should be studied. Another interesting research foresight would be to analyze how evolving tactical knowledge through the use of modified games where the number of tactical problems were limited or are exaggerated, and how would have bearing on learning and competition transfer to the teaching programs focusing on specific tactical problems.

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