

## DEVELOPMENT AND VALIDATION OF THE GAME PERFORMANCE EVALUATION TOOL (GPET) IN SOCCER

### DESARROLLO Y VALIDACIÓN DE LA HERRAMIENTA DE EVALUACIÓN DEL RENDIMIENTO DE JUEGO (HERJ) EN FÚTBOL

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#### Abstract

The objective of this article is to present the Game Performance Evaluation Tool (GPET) and the results of the validation and reliability processes said tool has undergone in order to be classified as a scientific evaluation tool. The GPET measures decision-making and the execution of technical-tactical actions in invasion games/sports. The version discussed herein is specific to football. The most significant contribution made by the GPET to the assessment of game performance is that it adopts a situated view to the basic tactical principles or problems proposed by Bayer (1992) with regard to attacking, retaining possession of the ball, advancing on the opposing goal and achieving the objective. Content validity was determined, and concurrent validity, intra-observer reliability (stability) and inter-observer reliability were measured. This evaluation tool has been shown to be a suitable means for assessing the tactical and technical behaviour of both on-the-ball and off-the-ball attackers.

**Keywords:** assessment, validity, reliability, game performance, soccer.

#### Resumen

El objetivo de este artículo es presentar la Herramienta de Evaluación del Rendimiento de Juego (HERJ, en inglés GPET) y los resultados de los procesos de medición de su validez y fiabilidad que este instrumento ha llevado a cabo con el fin de convertirse en una prueba científica de evaluación. El GPET mide la toma de decisiones y la ejecución de acciones técnicas tácticas en deportes de invasión. La versión que aquí se presenta es específica para fútbol. La aportación más significativa del GPET a la evaluación del rendimiento de juego es que adopta una perspectiva contextual desde los principios o problemas tácticos enunciados por Bayer (1992), los cuales son mantener la posesión del balón, avanzar hacia la meta rival y conseguir el objetivo. Se determinó la validez de contenido, y se midieron la validez concurrente, la fiabilidad intra-observador (estabilidad) y la fiabilidad inter-observador. Esta herramienta de evaluación ha demostrado ser adecuada para los fines relacionados con la evaluación del comportamiento técnico y táctico de atacantes con y sin balón.

**Palabras clave:** evaluación, validez, fiabilidad, rendimiento de juego, fútbol

## INTRODUCTION

Games performance assessment, which is understood as the combination of the decision-making component and the skill-execution component, is one of the most common areas of research in the games-teaching literature in Physical Education and Sports. This is mainly due to the need to ascertain three questions: a) the degree of learning of sportspersons; b) how do students and players learn to play games; and c) as a means of assessing skills and tactical understanding within the context of the game, rather than assessing skills outside the game, in isolation, a point which it is made below. In response to these needs, researchers have designed different game performance evaluation tools, developing and adapting them to the various requirements generated by the objectives of the studies they have carried out. There has been a gradual development away from measuring technical skills (passing, dribbling), performed in isolation, to an approach centred on the ability of sportspersons to resolve problems in real game play or game play situations. In this study an instrument that aims to improve the quality of the assessment of sportspersons in relation to invasion sports and from a situated view will be presented and explained at a later stage.

Rink, French and Tjeerdsma (1996) provide a breakdown of instruments that evaluate game

performance, setting down a continuum ranging from "what to do" to "how to do it". In the process, distinctions were made between tools for studying tactical awareness, game performance in controlled contexts and game performance in game contexts. This introduction will include a review of tools (or instruments) that have been developed in this third level in which game performance in game context is analysed, paying special attention to decision-making. The tool presented in this article specifically sets out to establish a relationship between the game context and the player's performance in it.

Major developments have been made in game performance evaluation and in decision-making in particular since the early 1980s. The first aspect researchers focused on in attempting to evaluate decision-making in real game play was the speed with which these decisions were taken, as this is a crucial factor in their success (Thiffault, 1980). However, effective decision-making is more than just a question of speed. Players must also execute what they decide to do correctly. As a result, researchers decided to focus more attention on measuring the accuracy of decisions than the speed with which they are made. French and Thomas (1987) designed perhaps the most widely used game performance evaluation instrument of the 1990s, a tool that has been adapted more than any other. This

instrument separates cognitive decision-making and the skill-execution components of performance. French and Thomas (1987) assume offensive basketball performance occurs following the sequence of catching, decision and execution. The decision component involves selecting the skill, which team-mate to pass to, what direction to dribble in, when to shoot, and when to stop dribbling, etc. Control was considered a separate component to motor execution due to the actions that typically occur following this sequence. Successful ball control, decisions and executions were coded 1, and unsuccessful ball control, decisions and executions were coded 0. The instrument was then adapted to other sports such as field hockey (Turner & Martinek, 1992; Turner & Martinek, 1999), handball (García Herrero & Ruiz Pérez, 2003), or a generic invasion game (Contreras Jordán, García López, & Cervelló Gimeno, 2005), and other roles such as off-the-ball players (Tallir, Musch, Lannoo, & Van de Voorde, 2003) or defenders (Méndez Giménez, 1998). Similar instruments in other categories of games were developed by McPherson and French (1991) for tennis; French, Werner, Rink, Taylor, and Hussey (1996), and (Blomqvist, 2001) for badminton; and French, Spurgeon, and Nevett (1995) for baseball.

Nevett, Rovegno, Babiarz and McCaughtry (2001) presented an instrument which went, in-depth, into the analysis of the actions sequence and focused on children's passing decisions, "off-the-ball" actions and catching-skill execution. Nevett et al. (2001) introduced the concept of the decision-making unit (DMU). Nevett et al. (2001) felt that a four-second time period was enough for team-mates to move into space to receive a pass. Previous instruments based on that concept from French and Thomas (1987) ignored the necessity of the framing analysis beyond the control-decision-execution sequence of on-the-ball players, so many decisions or unexecuted decisions were not measured. Blomqvist, Vääntinen and Luhtanen (2005) extended the analysis of DMUs to other types of decisions, such as holding the ball, scoring attempts, defence movements, defending against an opponent (guard or mark), providing defensive help (cover), trying to win the ball (duel or intercept), defending the goal and no-decision situations. Both Nevett et al. (2001) and Blomqvist et al. (2005) conducted their tests in game-test situations (Memmert, 2010, p. 200), which are "simple game forms with clearly defined game ideas, fixed numbers of players as well as defined rules and environmental conditions". In this evaluation tool the ball paths and actions of team mates and opponents are not standardized to assess children's tactical behavior.

The measurement of decision-making is interesting not only from a scientific viewpoint but also in didactic terms. A range of instruments has thus been designed for both purposes, with those developed by Oslin, Mitchell and Griffin (1998) and Gréhaigne, Godbout and Bouthier (1997) undoubtedly being applied more

widely around the world than any others. The Game Performance Assessment Instrument (GPAI) developed by Oslin et al. (1998, p. 233) "identify observable components of game performance that were applicable across four game categories". Not all of them may be applicable to a particular game. Oslin et al. (1998) identify seven components agreed in the development process of the GPAI:

- 1.-Base: Appropriate return of performer to a "home" or "recovery" position between skill attempts.
- 2.-Adjust: Movement of performer, either offensively or defensively, as required by the flow of the game.
- 3.-Decisions made: Making appropriate choices about what to do with the ball (or projectile) during the game.
- 4.-Skill execution: Efficient performance of selected skills.
- 5.-Support: Off-the-ball movement to a position to receive a pass (or throw).
- 6.-Cover: Defensive support for player making a play on-the-ball, or moving to the ball (or projectile).
- 7.-Guard/mark: Defending an opponent who may not have the ball (or projectile).

The GPAI is usually simplified, so only certain components are assessed both in teaching and research.

The Team Sports Assessment Instrument (TSAP) designed by Gréhaigne et al. (1997) takes into account both interactions between strategic and tactical efficiency, and technical efficiency. Components of performance in TSAP follow this sequence: gaining possession of the ball - actions when playing the ball. First, a player can conquer the ball (CB) or receive the ball (RB), and later a player can play a neutral ball, lose the ball, play an offensive ball (OB) or execute a successful shot (SS). Once the match is over, other measures can be obtained, like the number of attack balls (OB + SS) or the volume of play (CB + RB). Although the TSAP is not designed for other games but invasion games or volleyball (a net game), it establishes a very valuable sequence in assessment components to provide a global idea of the performance of on-the-ball players.

The purpose of this article is to report on the development and validation of the Game Performance Evaluation Tool (GPET). The GPET offers the possibility of analysing each decision made from the tactical viewpoint of the problem the player has to solve in the game play he or she is involved in. This approach goes a step further than the GPAI (Oslin et al., 1998) or TSAP (Gréhaigne et al., 1997) as they analyzed decision making and skill execution, but the result of their analyses was not related to the tactical

problems in which decisions were made and skills executed. French and Thomas (1987, p.18) assert that decision-making components of performance “would involve selection of the skill .... as well as which teammate to pass to, what direction to dribble, when to shoot, when stop dribbling, and so on”. Thus, previous instruments have typically assessed decision making on just one level, though two levels are possible. The first level, “response selection” involves the technical-tactical skill, with the teammate and opponent directly implicated in the action (e.g, passing the ball to an unmarked teammate). This might be best thought of as the decision-making question of “what is done.” But a second level of decision making would consider the tactical-context adaptation which might best be thought of as the question of “what should be done” in a particular game context or situation, which enriches the analysis from an ecological view. The game context is composed of all teammates and opponents that could have any influence in a segment of play as well as the area of the court where the action takes place. This is the main contribution of GPET.

## METHOD

### Development of the GPET

The teaching of games and sports from tactical approaches has introduced the notion of tactical problems (Mitchell, Oslin, & Griffin, 2006) or principles (Bayer, 1992). The GPET is an instrument that assesses game performance from a tactical view, coding decisions and executions according to the tactical problem subjects have to solve. Two roles are assessed: on-the-ball and off-the-ball attackers. The GPET assesses game performance at two different levels. At the first level, it assesses the adaptation of actions to tactical problems or contexts; at the

First level of assessment: the adaptation of actions to tactical problems or contexts

The adaptation of actions is referred to as 'context adaptation performance' and is defined as “the efficiency during the game in adapting the actions to the tactical context” (Gutiérrez Díaz del Campo, González Villora, García López, & Mitchell, 2011, p. 878). Game actions are first analysed according to the attack principles (Bayer, 1992) characteristic of the tactical problem: maintaining ball possession (1A), attacking (2A) and scoring (3A). The result of this analysis is the situation principle, the tactical context/problem the player is involved in during a moment of play. The player's capacity to identify problems that emerge during the game is assessed. In the video analysis of the start of the situation principle, group play through to the start of the game situation is observed. The sequence that follows, which lasts a maximum of four seconds, is what the researcher observes with a view to assessing the tactical context adaptation. Players choose an action according to one of the tactical principles (application principle). While the situation principle is the same for

all the players, as it is determined by the situation, actions, and interactions of all players, the application principle is determined by the individual actions of a player. Efficiency in this level of analysis is given by the coincidence or not of the situation principle and the application principle or in other words, between the tactical context and the tactical adaptation of the player. The criteria for classifying tactical problems are as follows:

General criteria:

1.As the main objective of the game is to score (3A), this principle will have priority over the other two. As a result, if a player is in a good position to shoot on goal, they should shoot. If they cannot shoot, but can attack (2A), they should do so. And only if they are in a position where they cannot shoot or advance on the opposing goal should they try to maintain possession.

2.The place on the pitch where the game situation occurs:

a.When the player is close to their own goal, with an equal or lower number of defenders and attackers, the action will be categorised as ball-retention (1A) if attacking (2A) is hazardous, as if the ball is lost in that area, the opposing team will have a chance to score.

b.Close to the opposing goal, provided that the context may be categorised as attacking (2A), even though there is some risk of losing possession (Castelo, 1999).

3.In the event that the game situation may be categorised by two or three principles due to it being ambiguous in some way, said possibilities will be recorded so that students' answers can be accepted if they come up with any of these options.

4.The main reference in categorising a game situation is, first of all, the position of the team-mates (attackers), and secondly, the position of the opponents.

Specific criteria in line with the role assessed:

On-the-ball attacker:

1.Maintaining ball possession (1A). There is no possibility of shooting on goal and there is a high risk of losing the ball:

a.The on-the-ball attacker has no chance of running with the ball or dribbling as a means of attacking as the direct defender is well positioned and, in addition:

i.There are no unmarked team-mates closer to the objective.

ii.There is a team-mate positioned further forward but they are not unmarked.

- iii. There is one or more on-the-ball attackers further forward and unmarked, but the pass may not reach them as there are no suitable angles for passing.
2. Attacking the opposing goal (2A). There is no chance of shooting on goal, but the player can attack without great risk of losing the ball:
    - a. When there is a team-mate further forward and in a better position the attack should be continued by passing, even if there is no chance to shoot on goal.
    - b. When there is no team-mate further forward and running with the ball/dribbling is the best option for attacking, as there is no direct opponent or there is a defender but they are out of position or there are fewer defenders than on-the-ball attackers, but there is no chance to shoot on goal.
  3. Scoring (3A). Whenever there is a chance to shoot or head at goal, except when:
    - a. Shooting is not a suitable option as the distance from goal is too great or the angle too narrow.
    - b. There is a team-mate who is better placed to shoot on goal.
    - c. The on-the-ball attacker may reduce the distance to the goal or improve the shooting angle to increase their chances of a more successful shot, without this involving the risk of losing the ball.

Off-the-ball attacker:

1. Maintaining ball possession (1A):
  - a. The on-the-ball attacker is in a situation in which they may lose possession and the off-the-ball attacker should make a run off the ball to support them.
  - b. They move into position behind the on-the-ball attacker to provide defensive support.
2. Attacking the opposing goal (2A):
  - a. There are free spaces the Off-the-ball attacker can move into between the position that the on-the-ball attacker is in and the opposing goal.
  - b. If the ball is close to the byline and the off-the-ball attacker moves into space further away from the goal but in search of an ideal position from which to shoot.

Following analysis of the context (situation principle), the suitability of the subject's response to said context is assessed, which it has been called the application principle. For example, if the on-the-ball attacker is in a clear scoring position, their situation principle is 3A. If they shoot in this context, they are applying principle 3A, but if they decide to pass the ball to a team-mate

positioned behind them, who starts the move again, they are applying principle 1A. In the first example it is deemed that the subject has made a suitable response and is given a coding of 1. In the second example the subject has not made a suitable response to the context and is given a coding of 0. Given the ambiguity of some game situations, the criteria for allocating the application principle are explained below:

On-the-ball attacker:

1. Maintaining ball possession (1A):
  - a. The player runs with the ball, dribbles or plays a pass, although neither they nor the player receiving the pass move closer to the objective (at a shorter distance in a straight line from the goal or in a position from which they can score).
  - b. The player remains in the same place (for more than four seconds, the time reference adopted by Griffin, Dodds, Placek and Tremino, 2001) while playing a one-two (there is a defender close by) or not performing any technical-tactical move.
2. Attacking the opposing goal (2A). The player places or is about to place the ball in a position that is closer to the objective, either by means of a pass or by running or dribbling with the ball.
3. Scoring (3A): the player shoots on goal with the intention of scoring.

Off-the-ball attacker:

4. Maintaining ball possession (1A): the player makes a decoy run (providing defensive balance) closer to their goal than the ball or moves into space or is already in space to receive possession in a position closer to their goal than the position of the ball.
5. Attacking the opposing goal (2A): the player moves into space or is already in space to receive possession in a position closer to the opposing goal than the position of the ball, or moves into space in any direction in order to receive an assist or make a decoy run to help their team-mates to attack.

At the second level, the GPET separates the cognitive decision-making components of performance and the motor skill-execution components of performance (French & Thomas, 1987). We assume control-decision-execution as the usual sequence of performance in soccer for on-the-ball players, and control was considered a separate component from motor execution due to the actions that typically occur following this sequence (French & Thomas, 1987). Off-the-ball player's actions are assessed in relation to on-the-ball player actions. Successful ball control, decisions, executions and movements were coded 1,

and unsuccessful ball control, decisions, executions and movements were coded 0.

Control, pass, dribbling, shoot and support are evaluated. Coding procedures are described in table 1 and 2. The only skill not to be given a double score was control, which was deemed to involve execution only, as it is an action carried out prior to a decision being made (French and Thomas, 1987). There are also a series of behavioural actions that are encoded but which are not analysed due to the relative infrequency with which they occur. These behavioural actions are

as follows: looking on, passive behaviour or watching the play without getting involved; 50-50 balls, game situations in which neither side is in possession of the ball, ie, in which no player is in possession; continuation of a game situation, when the game situation unfolds so quickly that some players are unable to take part in it; and decoy runs or remaining stationary, movement or lack of movement by the off-the-ball attacker so that the direct defender follows them and thereby improves the attacking options of other team-mates. All these actions have been grouped together in a category entitled Others.

**Table 1. GPET second-level coding procedures for on-the-ball attackers (soccer)**

Control
Coded as 1
<ul style="list-style-type: none"> <li>• The player receives or controls the ball with one or two hands/feet in order to then play it (bounce/driving, passing, shooting).</li> </ul>
Coded as 0
<ul style="list-style-type: none"> <li>• The player does not control the ball and it runs away from their hands/feet.</li> </ul>
Decision making
Passing
Coded as 1
<ul style="list-style-type: none"> <li>• Passing to a teammate who is unmarked.</li> </ul>
Coded as 0
<ul style="list-style-type: none"> <li>• Passing to a player who is marked closely or there is a defensive player in a position to cut off the pass.</li> <li>• Passing to an area of the pitch where no team-mate is positioned.</li> </ul>
Dribbling
Coded as 1
<ul style="list-style-type: none"> <li>• Taking the ball upfield, while not closely marked, to a free space.</li> <li>• An appropriate change of direction away from a defender (right or left) to an open area of the pitch.</li> <li>• The player advances by positioning their body between the opponent and the ball in order to protect the ball.</li> <li>• The player does not move and protects the ball with their body when the defender pressurises them, and does not have the option of attacking.</li> </ul>
Coded as 0
<ul style="list-style-type: none"> <li>• Charging.</li> <li>• Dribbling when there is an unmarked team-mate in a better position.</li> <li>• A player running with the ball at their feet when an opponent is close and has a very good chance of winning the ball.</li> <li>• A player running with the ball at their feet when an opponent is close and without protecting the ball with the body.</li> <li>• Dribbling away from the goal, dribbling with the ball without going forward or attacking the defence.</li> <li>• The player does not move and does not protect the ball with their body when the defender pressurises them, and does not have the option of attacking.</li> </ul>
Shooting
Coded as 1:
<ul style="list-style-type: none"> <li>• Shooting on goal from a suitable distance when unmarked or not under pressure.</li> </ul>
Coded as 0:
<ul style="list-style-type: none"> <li>• Shoots from too far out.</li> <li>• Shoots when the defender is pressuring them.</li> <li>• Shoots when it is better to pass to an unmarked team-mate in a more advanced position or in a better position to shoot.</li> </ul>

## Execution

## Passing

## Coded as 1

- Successful pass to a teammate: to their body if they are stationary, lead pass if they are running.
- Appropriate length and speed.

## Coded as 0

- Interception.
- Pass is too hard.
- Out of play.
- Pass is too far behind or in front of a teammate.

## Dribbling

## Coded as 1

- Attacking with the ball successfully.

## Coded as 0:

- Loss of control.
- Loss of ball due to legal challenge.
- Commits a foul (offensive foul).

## Shooting

## Coded as 1

- Shot on goal, long way from the goalkeeper.

## Coded as 0

- Shot off target.
- Shot on goal, near to the goalkeeper.

**Table 2. GPET second-level coding procedures for off-the-ball attacker (soccer)**

## Decision-making

## Support

## Appropriate decision (1).

- Takes up or remains in an unmarked position, at a suitable distance to receive a pass and with a passing angle.
- Feints to receive a pass, creating a passing angle.

## Inappropriate decision (0).

- Takes up a position close to an opponent.
- Takes up the space that a team-mate on the ball is about to run into.
- The player is stationary or is being marked, and does not make a pass possible.
- Commits a foul: an offensive foul, enters a prohibited area (handball area, offside), etc.
- Takes up a position in which the passing player is unable to pass the ball to.

## Execution

## Support

## Successfully completed actions (1).

- Succeeds in leaving their marker behind.
- Takes up an unmarked position with the possibility of receiving a pass.

## Actions that are not completed successfully (0).

- Player unable to shake off their marker.
- Remains stationary and doesn't make space to receive a pass from a team-mate when the opportunity arises.

Two temporary parameters were created to encode the game: the game situation and the decision-making action or unit (DMU). Figure 1 shows the GPET data sheet for each player evaluated. The game situation is the portion of real play that elapses from the change in possession or restarting of play to the interruption of play or a subsequent change in possession. The game situation is the unit it has been used to break down the analysis of the recordings. Each of the participants were analysed in each game situation, starting with the on-the-ball attacker and continuing with the rest of the off-the-ball attackers. The main aim in recording the game situations was to put the actions occurring in the game into an orderly sequence and thereby make it easier and quicker to review the recordings, both for researchers in reviewing anomalous data, and for other researchers reviewing other data at a later stage. This recording also makes it easier to

commence analysis sessions anew as, due to the volume of work required to analyse all the GPET variables, it is not always possible to analyse a complete game in a single session, which is a limitation of the instrument, particularly in practical settings. Although this is the main objective, other data of interest is also recorded, such as the types of action that complete game situations (loss of possession, regaining of possession, goal, etc), the number of game situations per match, actual playing time and the average duration of each game situation. All this data is essential in studying the depth of the game characteristics. In the first viewing of the recording the parameters governing the game situations are recorded: timecoding (the time at which the game situation starts and ends and its duration); and the action that brings the game situation to an end (eg, a goal or regaining of possession).

Figure 1. Data sheet.

DMU		Tactical problem		On-the-ball attacker			Off-the-ball attacker		
N°	Time	Situation principle	Application principle	C	DM			Support	
					P	D	S	DM	Ex
1									
2									
3									
4									
5									

DMU: Decision Making Unit; DM: Decision Making; Ex: Execution; DM: Decision Making; Ex: Execution; C: Control; P: pass; D: Dribbling; S: Shot.

The DMU is the fraction of game situation in which the player performs a single technical-tactical component in a game context defined by a single contextual principle. When the player performs a new technical-tactical component, therefore, they apply it in a new context or with a different intention (a different application principle), and the DMU changes. Obviously, this also changes the role-changing action. Due to the nature of invasion sports, it was also decided to create a temporary criterion, which means that even in the circumstances described, a new DMU is counted every four seconds for analysis purposes (Nevett et al., 2001). The following are analysed in each DMU: situation and application principles (the first analysis level of the GPET), and the decision-making and execution of the attackers in the role they perform in it (on-the-ball attacker or off-the-ball attacker).

Below is described, by way of example, a possible action performed by the on-the-ball attacker and how it would be encoded. The on-the-ball attacker is in a context that is defined as “attacking” or 2A because they have space in front of them and they may advance without being in any danger of losing possession. In this context the player runs with the ball, away from the objective, and moves into space. This action is

encoded as 2A-1A, which equates to an incorrect adaptation of the game context, as in an attacking context (2A) the player reveals an intention to maintain possession (1A). As regards the technical-tactical component of dribbling, the player correctly decides to occupy space (given a 1 coding), and the execution is also successful as they do not lose possession (given a 1 coding).

#### Validity and reliability

Content validity was determined through a panel of experts. Six physical education teachers/coaches with more than 10 years of experience in teaching invasion games, and specifically soccer, were asked to examine all categories of analysis of the GPET independently and provide feedback on them. All their contributions were considered and the result was the instrument detailed above.

A type of criterion validity that involves correlating an instrument with a certain criterion that is administered at about the same time is called concurrent validity (Thomas, Nelson, & Silverman, 2005). The sample was made up of four age groups (7-8, 9-10, 11-12 and 13-14 years) and two performance levels (expert soccer players and novice players). The following criteria were

used to establish expertise: the amount of weekly and accumulated deliberate practice, experience in official competitions, and the judgment of the club coach. The expert players belonged to the youth program of the Albacete Football Club (Spain) and were selected by their coaches as being the best performers on their teams. They had all accumulated at least one year of deliberate practice (more than three hours per week) and they all had experience in official competitions. The novice players were selected from a group of Physical Education students with no formal training in invasion games and without any experience in official competitions. All subjects were evaluated in different

versions of soccer, depending on the age group. The games were selected based on the developmental abilities and previous training for each of the groups in such a way that they would be able to reach the maximum level of achievement in the decision-making component of performance. The number of players per team and the size of the playing field were also changed since they are important structural components that have great influence on the number of stimuli present in the decision-making processes (Table 3). The concurrent validity coefficient was obtained by correlating the scores on game performance and level of expertise.

**Table 3. Sample sizes in each category for the four groups, and game form in which players were evaluated**

Age group (years)	PE students (grade, age)	<i>n</i> (boys; girls)	Soccer players (category)	<i>n</i> (boys)	Game form (players, mxm)
7-8	Grade 2	16 (8; 8)	U9	14	2 vs 2, 20_10
9-10	Grade 4	20 (8; 12)	U11	14	3 vs 3, 30_15
11-12	Grade 6	19 (7; 12)	U13	13	5 vs 5, 52_40
13-14	Grade 8	19 (8; 11)	U15	14	7 vs 7, 70_52

Two researchers were trained in the use of GPET during eight periods of one hour. After the training, intra-observer reliability (stability) was measured, with the 3 vs 3 video record being analysed twice. Two weeks elapsed between the first and second notations in order to minimise bias between codings. Spearman's rho rank correlation determined the researcher's ability to reproduce results of this ordinal data. Passing and dribbling in the third tactical context and shooting in the first and second tactical contexts were not analysed, because only eight behavioural actions were observed, an insufficient amount for correlation. Inter-observer reliability was measured by conducting ANOVA, with the codings of both researchers being compared.

## RESULTS

Different games have been used to measure different kinds of validity and reliability. All games lasted eight minutes, but the number of actions in each game differed as the pitches, number of players and level of expertise were different.

### Concurrent validity

A total of 3430 discrete actions were observed in inexperienced players (control, 10.44%; passing, 15.80%; dribbling, 17.93%; shooting, 5.52%; support, 57.26%;

others, 4.48%) and 2392 in experienced players (control, 7.31%; passing, 19.10%; dribbling, 10.45%; shooting, 5.14%; support, 42.82%; others, 9.15%). Significant negative correlations were found between players performance and their level of expertise (level 1: experienced; level 2: inexperienced). The more experienced the players, the higher their performance. Not all variables of GPET were found to be useful as a means of observing concurrent validity, though most of them are as it is shown as follows. Adaptation to tactical context is valid in the first tactical context ( $r = -.669$ ,  $p < 0.01$ ) and in the second tactical context ( $r = -.742$ ,  $p < 0.01$ ). The third tactical context did not yield positive results as shooting is an action that is not performed enough. In relation to performance, the results for decision-making with regard to passing (1A, 2A), dribbling (2A), shooting (3A) and support (1A, 2A), and the execution of passing (1A), shooting (3A), and support (1A, 2A) are shown in table 4. Some correlations were not measured due to the reduced number of behavioral actions in certain tactical contexts, such as shooting to maintain possession of the ball, or moving into space to win a point (in invasion games points cannot be won by moving into space). The correlations in the sample vary due to the fact that not all the subjects performed all the actions.



used to establish expertise: the amount of weekly and accumulated deliberate practice, experience in official competitions, and the judgment of the club coach. The expert players belonged to the youth program of the Albacete Football Club (Spain) and were selected by their coaches as being the best performers on their teams. They had all accumulated at least one year of deliberate practice (more than three hours per week) and they all had experience in official competitions. The novice players were selected from a group of Physical Education students with no formal training in invasion games and without any experience in official competitions. All subjects were evaluated in

different versions of soccer, depending on the age group. The games were selected based on the developmental abilities and previous training for each of the groups in such a way that they would be able to reach the maximum level of achievement in the decision-making component of performance. The number of players per team and the size of the playing field were also changed since they are important structural components that have great influence on the number of stimuli present in the decision-making processes (Table 3). The concurrent validity coefficient was obtained by correlating the scores on game performance and level of expertise.

**Table 4. Pearson correlation between level of expertise and performance (decision making and execution)**

	Control	Passing		Dribbling		Shooting	Support	
		1A	2A	1A	2A		3A	1A
Decision making		-.639**	-.597**	.125	-.551**	.016	-.718**	-.662**
Execution	-.547**	-.744**	.064	-.101	.008	.690**	-.772**	-.287**

1A: Maintaining ball possession; 2A: Attacking the opposing goal; 3A: Scoring. \*  $p < .05$ ; \*\*  $p < .01$

### Intra-observer reliability

A total of 343 discrete actions were observed (control, 16%; passing, 22%; dribbling, 17%; shooting, 7%; support, 40%; others, 1%). In terms of adaptation to the tactical context positive results were recorded in all of them (1A,  $r = .976$ ,  $p < .01$ ; 2A,  $r = .0976$ ,  $p < .01$ ; 3A,  $r = 1.000$ ,  $p < .01$ ). As shown in Table 5, intra-

observer reliability values exceed 0.7 in all cases, except in the execution of the pass in the context of attacking with an objective, which has a Spearman rho of 0.464,  $p < 0.05$ . In the shooting and decoy run variables there is a 100% match, although the number of actions observed was so small the correlation coefficient could not be calculated.

**Table 5. Intra and inter-observer Spearman correlation**

		Control	Passing		Dribbling		Support	
			1A	2A	1A	2A	1A	2A
Intra-observer	DM		.750*	.464*	1.000**	.906*	1.000**	.929**
	EX	.952*	.955*	.928**	.970**	.707	1.000**	.976**

DM: Decision Making; Ex: Execution; 1A: Maintaining ball possession; 2A: Attacking the opposing goal; 3A: Scoring. \*  $p < .05$ ; \*\*  $p < .01$

### Inter-observer reliability

A total of 514 discrete actions were observed (control, 8%; passing, 21%; dribbling, 16, %; shooting, 6%; support, 40%; others, 9%) in the same natural sequence. One way ANOVA did not show significant differences in any variable, neither those relating to adaptation to tactical context nor those relating to performance.

## DISCUSSION

In this article a process for measuring the validity and reliability of the GPET has been presented, an

instrument designed to evaluate game performance in invasion sports, the version of which presented in this study is adapted to football. This evaluation tool has been shown to be reliable and valid for assessing the behaviour of both on-the-ball and off-the-ball attackers. The main asset provided by the GPET is that it measures individual game performance categorised according to the game context in which the action is performed. Secondly, the GPET also provides a measurement in which the player under analysis is able to recognise and provide a response tailored to the tactical context, a response that resolves the game problem they are faced with. None of the instruments predating the GPET

have taken this factor into account in analysing game performance. This contextualization of game actions through the application of the attack principles proposed by Bayer (1992) represents a significant step forward in the development from a behavioral to a more ecologically cognitive perspective.

All the experts who participated in content validity procedures in the adaptation to the tactical context agreed in the descriptions contained in the final version of the instrument. However, the validity criterion did not provide a positive result for the third tactical context, namely scoring. The lack of shooting actions were not considered a significant drawback as not all variables were used to categorize players in terms of their skill level, especially when the action of shooting occurs so infrequently in football. This was not the case in the first and second tactical contexts where shooting was not considered, and correlation values of around .7 and a significance of  $p < .001$  were obtained.

With regard to intra-observer reliability, correlation coefficients were no lower than .927, except in decision-making when passing, both within the context of maintaining possession ( $r = .750$ ) and attacking ( $r = .464$ ), although the correlation is still significant in both cases. The correlation could not be calculated again in the third coefficient due to the insufficient number of actions, as many of the subjects did not have the opportunity to shoot on goal, which is common in football, as would be the case with concurrent validity. Other studies have encountered similar problems. Thomas et al. (2009) do not analyse this variable, and Blomqvist (2001), in badminton, also found the lowest correlation values in the decision-making variable for shooting.

Although the GPET is an instrument designed ostensibly for research purposes, it can be applied to football training and teaching. Teachers and coaches can select specific tactical contexts and, within them, the components that occur in said contexts, focusing on the learning objective in question. They can thus simplify the evaluation process by adapting it to the time periods available to the coach or teacher. Because of its complexity, the GPET is not an instrument that can be used by the students themselves, unlike the TSAP and the GPAI (Grehaigne et al., 1997; Oslin et al., 1998).

The GPET also offers a complete perspective of the attacking game as it assesses the roles of the on-the-ball attacker and the off-the-ball attacker. The inclusion of this second role has important implications, as the transfer of learning is considerable in off-the-ball actions due to their high degree of similarity in

invasion sports (García López, Contreras Jordán, Penney, & Chandler, 2009; Martin, 2004). Other instruments enable the evaluation of defensive aspects, such as the GPAI proposed by Oslin et al. (1998), although in this study analysis does not take into account the tactical context in the level reached by the GPET. Future publications will provide information on the validation of defensive roles through the GPET. Codings for a series of behavioral actions that are difficult to categorise, and which may be ambiguous for the observer, have also been entered, such as the watcher player, 50-50 balls, continuation of the game situation and the making of decoy runs. In this respect, Grehaigne et al. (1997, p. 510) carried out a similar analysis of passes that do not really put the other team in jeopardy, considering them “neutral balls” and not including them in TESAP's efficiency formula.

## RESEARCH PROSPECTIVE

The GPET is an instrument that can be developed in a number of ways. In addition to the aforementioned inclusion of defensive roles, other contributions could enrich and complement the already interesting alternatives it provides. When analysing decision-making it could be useful to bring in the concept of the area of the pitch in which the game situation is taking place (Lago, 2002). The concept raised by this author allows a distinction to be made based on the distance to the ball and other factors, on whether a player may intervene in the game situation to be analysed, and, therefore, whether their behavioral actions should be encoded. This is one way of measuring the usefulness of a certain intervention in a game situation. Key game situations also require evaluation (eg, goal assists), as do other situations, which are subject to special rules (eg, passes at throw-ins or corner-kicks).

Another aspect that impacts significantly on evaluation quality is that of finding out the time available to the player to make decisions and the time they use in making them. This is without doubt one of the key factors in assessing the quality of a decision, and can reveal if a subject can play in a higher or lower category. The inclusion in the decision-making evaluation process of group components (eg, one-two), which involve the collaboration of at least two players, or of the adaptation to basic game systems (eg, zonal or mixed defence) are other possibilities worth considering. In any case, due to the extreme complexity of evaluation instruments, it is increasingly clear that the development of these instruments should be accompanied by the development of software that allows the process to be simplified and timeframes shortened, so that results may be made available more quickly and used in sports teaching processes.

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