

RELATIONSHIP BETWEEN DECISION-MAKING AND PERFORMANCE IN GAME ACTIONS IN VOLLEYBALL

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ABSTRACT

The aim of the study was to analyze the relationship between decision-making and performance in three game actions (reception, setting, attack), in male volleyball, U-19 category. The systematic observation was used to analyze 4014 game actions (1348 receptions, 1360 sets, 1306 attacks), corresponding to the 21 teams participating in the male U-19 Spanish Championship, held in 2012. Decision-making was associated to performance, in the actions of reception (.461**), setting (.750**), and attack (.276**). This results highlight the relevance of decisional skills in game actions' performance, that contribute to team final performance. Therefore, it would be appropriate to include decisional task in the process of training youth players, in order to improve their decisional skills, in these game actions.

Key words: cognitive processes, performance, reception, setting, attack

RELACIÓN ENTRE LA TOMA DE DECISIONES Y EL RENDIMIENTO EN LAS ACCIONES DE JUEGO EN VOLEIBOL

RESUMEN

El objetivo de este estudio fue analizar la relación entre la toma de decisiones y el rendimiento en tres acciones de juego (recepción, colocación, ataque), en voleibol de categoría Juvenil Masculino. Se analizaron mediante la observación sistemática 4014 acciones de juego (1348 de recepción, 1360 de colocación, 1306 de ataque), correspondientes a los 21 equipos participantes en el Campeonato de España Juvenil Masculino, celebrado en 2012. Los resultados mostraron una asociación significativa entre la toma de decisiones y el rendimiento en juego, en la acción de recepción (.461**), colocación (.750**), y ataque (.276**). Estos resultados muestran la importancia de poseer adecuadas capacidades decisionales para obtener un óptimo rendimiento en las diferentes acciones de juego, y contribuir así a mejorar el rendimiento final del equipo. Por tanto, en el proceso de entrenamiento de jugadores de categoría juvenil sería apropiado considerar la posibilidad de empleo de actividades que contribuyan a la mejora de la capacidad decisional de los deportistas, en estas acciones de juego.

Palabras clave: procesos cognitivos, eficacia, recepción, colocación, ataque

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INTRODUCTION

Decision-making is one of the key factors that can affect performance in sport (Williams, Singer & Frehlich, 2002). The study of decision-making should take into account the sports peculiarities, and the different game contexts of each sport (González-Villora, García-López, Pastor & Contreras, 2011).

Decision-making can be defined as the process by which the athlete chooses how to act or react to the demands of the environment, to achieve different performance objectives (Hodges, Huys & Starkes, 2007). In this sense, it involves the detection of adequate information from the environment, to plan future actions, and thus be able to face the contingencies of the game (Baker, Whiting, & Van der Brugg, 1992). Therefore, we can consider decision-making in a sport situation as the most appropriate response selection to the different game conditions (MacMahon & McPherson, 2009).

The study of decision-making in sport has been carried out through different perspectives. The ecological perspective proposes that the most relevant information for decision-making arises from the continuous interactions between the athlete and the environment, giving importance to perception into decision-making process (Araújo, Davids & Hristovski, 2006; Van Orden, Holden & Turvey, 2003). On the other hand, from a cognitive perspective, athletes' performance depends on the internal mental representations and the cognitive processes that mediate between the interpretation of a stimulus and the response selection (Sutton & Mcilwain, 2015). The present study emerges from the cognitive perspective.

Within the cognitive perspective, the most relevant model oriented to the study of the memory processes states that the knowledge structures stored in the memory determine the decision-making. Thus, the bigger and more varied the knowledge, the better the athletes' decisional ability (Köppen & Raab, 2009). These studies indicate that athlete's performance depends, to a great extent, on the mental representations and cognitive processes between the interpretation of a stimulus and the subsequent response selection (Hodges, Starkes & MacMahon, 2006). In this way, the athlete's knowledge of sport itself will serve as the basis for an effective response selection (Starkes, Helsen & Jack, 2001, Williams, Davids & Williams, 1999).

The more open the sports skill is, the greater number of stimuli that must be perceived and processed, so that the action will be more complex in terms of decision-making (Greháigne et al., 2001). For example, in the different volleyball game actions there is a wide field of uncertainty, so the response selection will be complex in the different moments of the game (Thomas & Thomas, 1994). For this reason, and due to the particular characteristics of sports context, collective sports are very interesting for the study of decision-making (Johnson, 2006) and cognitive processes (Moran, 2012).

Numerous investigations, in different sports, have tried to determine the relationships between the different cognitive variables and game performance (Hastie, Sinelnikov & Guarino, 2009, Iglesias, Moreno, Santos-Rosa, Cervelló & Del Villar, 2005, Nielsen & McPherson, 2001). The developed studies have shown a positive and significant correlation between cognitive and performance variables (Conejero, Claver, Fernández-Echeverría, Gil-Arias & Moreno 2017, French & Thomas, 1987, Iglesias, Sanz, García-Calvo, Cervelló & Del Villar, 2005).

In volleyball, Moreno et al. (2006) and Murray (1991), analyzed the relationship between knowledge, decision-making, execution and team performance. In both studies the results determined that a greater experience and knowledge of volleyball, allowed the athlete a better decision-making and, therefore, greater performance in the different game actions. Thus, teams with players that take better decisions were better ranked in the final classification. The present investigation will analyze the relationship between decision-making and performance in different volleyball game actions, which have different perceptual, decisional and execution characteristics.

In volleyball, the actions are cyclical and sequential (Beal, 1989, Fraser, 1988) occurring in six fundamental game complexes K0, K1, K2, K3, K4 and K5 (Cesar & Mesquita, 2006; Laporta, Nikolaidis, Thomas & Afonso, 2015).

The reception is the first action of a team after the opponent serve. This action is the first inside the K1, being the main weapon to counteract the serve. The reception is essential, being considered intermediate action because, through it, a direct point can not be obtained (Mesquita, Manso & Palao, 2007; Palao & Martínez, 2013). But, its correct execution will facilitate the construction of the attack, getting points that can be decisive in the final result (Junior, Antonio & Deprá, 2010). In this action, the reception systems used, the distribution of responsibilities between players and the predetermined area to which the received ball should be directed, play an important role at the decisional level, not giving players too many options for creativity in this action (Ureña & González, 2006). At the perceptual level, the time available to decide can be set at 150 ms, so the receiver must anticipate the opponents' action (Baker, Whiting & Van der Brug, 1992, Ezquerro & Buceta, 2001), collecting information from the relevant signals of the serve player movement and the flight of the ball, to make decisions in the reception (Seung-Ming, 2010). The setting is the second action in the game cycle, both in K1 and in K2, is made by a player specialist, the setter, who sends the ball trying to get the attackers to have the best conditions against the blockers (Palao & Martínez, 2013). The setter is the player who take most decisions, from the tactical point of view, since is the one who decides where to send the ball for the attack (González-Silva, Moreno, Fernández-Echeverría, Claver & Moreno, 2015). Being an action

through which direct point can not be obtained, it is considered an intermediate action. However, it is one of the most important actions, since a high percentage of the attack effectiveness depends on the quality of the setting (Bergeles, Barzouka & Elissavet, 2009), affecting the final result of the game (Silva, Lacerda & Joao, 2007). The attack is usually the third contact of the team, being considered as the main offensive weapon of a team to obtain a direct point (Drikos, Kountouris, Laios & Laios, 2009), as a finalist action. Among all the finalist actions, the attack has the highest correlation with efficacy. In this way, it is the action with the greatest contribution to the team's victory, thus becoming the greatest indicator of success in volleyball (Castro & Mesquita, 2010). In the attack action, player has to attend to a high number of stimuli, with a reduced time to decide (Ureña & González, 2006). At the perceptual level, the time to make decisions ranges between 300 and 500 milliseconds, while the ball flies from the hands of the setter to the attacker (Sellinger & Ackerman, 1985).

A reduced number of studies have analyzed the relationship between decision-making and performance in the different game actions, and less of those have focused this analysis in volleyball training categories. Therefore, the main aim of this research is to analyze the relationship between decision-making and performance in different game actions (reception, setting, attack), in male volleyball, U-19 category.

METHOD

Participants

The sample of the study was composed of 4014 game actions executed by the 221 players, of the total 21 participating teams of the Spanish Club Championship, U-19 category, held in 2012.

The distribution of the different actions observed was as follows: 1348 receptions, 1360 setS (both after reception and defense), and 1306 attacks. The systematic observation of the game actions was carried out in two matches of each one of the participating teams. All the matches corresponded to the first phase of the championship.

Variables and instruments

Two types of variables are considered in the research: cognitive (decision-making) and performance (performance in game actions).

– The decision-making in the actions of reception, setting and attack, defined as the process through which an athlete selects an action among the alternatives, to execute it in a real game situation (Tenenbaum, 2004), taking into account the demands of the environment, in order to achieve the different performance objectives (Hodges et al., 2007). Decision-making was measured

through the Game Performance Assessment Instrument (GPAI), developed by Oslin et al. (1998). This instrument is used to observe and code sports actions that demonstrate the player's ability to solve tactical problems. This instrument is composed by 7 factors, analyzing in the present study the one referred to decision-making. For each action, a value of 1 was assigned to appropriate decisions, that met the established criteria, and a value of 0 to those that were inappropriate, that did not meet those criteria. The instruments were validated and used in previous studies, as well as in the reception (Conejero, Claver, Fernández-Echeverría, González-Silva & Moreno, 2017), setting (Moreno, Moreno, Ureña, García-González & Del Villar, 2008) and attack (Moreno, Moreno, García-González, Gil, Claver & Del Villar, 2011).

– The performance in the actions of reception, setting and attack, understood as the final result of the motor execution. The measurement was made through the Observation System of the International Volleyball Federation, FIVB (adapted from Coleman, 1975). This instrument consists of a scale in which values are given from 0 to 4 in each attack finalist action, and from 0 to 3 in the intermediate actions of reception and setting. Where 0 means point for the opponent and 4 the successful execution of the action (3 in reception and setting).

Procedure

For the systematic observation of the decision-making and performance in game actions, recordings of the different matches were made. The recordings were made with a SONY HDR-XR155 digital camera on M2TS format. The camera was placed in the background of the court at a height of 5 meters above the ground, which allowed to obtain a similar plane in the different recordings.

Once the data collection was done, all the matches were observed by an observer. To guarantee the reliability of the observation, an observer with experience in this function (Graduated in Physical Activity and Sports Sciences, National Level III Volleyball Coach, and with experience as a coach), carried out a training process. In the different training sessions, matches with different characteristics (from different ranked teams), and exceeding 10% of the total sample, indicated by Tabachnick & Fidell (2013). Intra-observer Cohen Kappa values higher than .75 were achieved in the observation of all variables (Fleiss, Levin, & Paik, 2003).

Statistical analysis

The statistical program SPSS 21.0 (Chicago, IL) was used as computer support for the analysis of the collected data. A correlation analysis was carried out, as well as an inferential analysis to determine the associations and the degree of dependence of each one of the studied actions in its different

variables (decision-making and performance). This analysis is presented through the contingency tables including Spearman's Rho values, Goodman and Kruskal's Gamma coefficient, and Somers' D coefficient, taking into account that the level of significance was established at $p < .05$.

RESULTS

Correlation analysis between decision-making and performance in reception

The statistical analysis shows a significant association between decision-making and performance in the reception action (Table 1). In addition, there is a high association between both variables (Gamma = .664), and a moderate level of dependence between them (Somers D = .400).

TABLE 1
Bivariate correlations of reception.

Variables	1	2
1.Reception decision-making	-	
2.Reception performance	.461**	-

*Correlation is significant at level .05

***Correlation is significant at level .01

Correlation analysis between decision-making and performance in the setting action

The statistical analysis allows verifying the existence of a significant association between decision-making and performance in the setting action (Table 2). In addition, there is a perfect association between both variables (Gamma = 1), and a high level of dependence between them (Somers D = .727).

TABLE 2
Bivariate correlations of setting.

Variables	1	2
1.Setting decision-making	-	
2.Setting performance	.750**	-

*Correlation is significant at level .05

***Correlation is significant at level .01

Correlation analysis between decision-making and performance in the attack action

The statistical analysis allows verifying the existence of a significant association between decision-making and performance in the attack action (Table 3). In addition, there is a moderate level of association between both

variables ($\Gamma = .399$), and a low level of dependence between them (Somers' $D = .246$).

TABLE 3
Bivariate correlations of reception.

Variables	1	2
1.Attack decision-making	-	
2.Attack performance	.276**	-

**Correlation is significant at level .05*

****Correlation is significant at level .01*

DISCUSSION

The objective of the study was to analyze the relationship between decision-making and performance in different game actions (reception, setting, attack), in U-19 category male volleyball. The results indicate that decision-making correlates with performance in the studied actions.

The results of the present study are in line with other studies that relate decision-making and performance in different sports (McPherson, 1999, Nielsen & McPherson, 2001). Specifically, different studies showed that players who take the right decisions had a better performance, in baseball (McPherson, 1993), badminton (Hastie et al., 2009) or tennis (Del Villar et al., 2007; García-González, Moreno, Moreno, Iglesias, & Del Villar, 2009; Nielsen & McPherson, 2001).

The present study show that decision-making in the reception action is significantly associated with performance in reception, with a high association between both variables, and a moderate level of dependence among them, what can suggest that there are other variables that affect performance. In the reception action, no studies have been found relating decision-making with performance.

The reception is considered an intermediate action that favors the game sequence, defense and setting, aiming to neutralize the serve of the opposing team and thus facilitating the construction of the team's own attack, allowing all attack options and increasing its efficacy (Gil, Moreno, Moreno, García-González & Del Villar, 2010, Ureña et al., 2010). At the reception, the player does not have total control of the ball, since it comes from the serve of the opposing team. At the perceptual-decisional level, the reception has a medium difficulty, comparing it with other actions (Ureña & González, 2006). There is no risk related to the objective, the confusion or conflict of the stimuli is medium and there are tenths of a second to decide, so the receiver must anticipate the action of the opponent (Ezquerro & Buceta, 2001, Ureña González, 2006). Therefore, this action is conditioned by the trajectory and speed of the serve (Quiroga et

al., 2012). So, to take decisions in this action, receiver needs to obtain information on server movement and also on the ball, (Seung-Ming, 2010). In volleyball, the reception is highly conditioned by the use of highly predetermined reception systems (Macquet, 2009), which can limit decision-making and strategic planning by players. Therefore, during the reception training, players must work with positional, orientation and movement aspects that can optimize the decision-making in this game action, in order to finally improve the reception performance.

In the present study, decision-making in the setting action is significantly associated with setting performance, with a perfect association between both variables, and a high level of dependence between them. Similar results were obtained in the study developed by Moreno et al. (2008). The decision-making showed by setters of the senior Spanish national team, correlated with its performance. In line with these results, Ramos et al. (2004), in other work with setters, also found significant correlation between decision-making and setting performance.

The setting is an essential action in volleyball, not only from the point of technical view, but also from the tactical, as it will affect the attack, being the setter the specialist player (Ureña & González, 2006). From the perceptive-decisional point of view, it has a medium level of difficulty, since there is high time for decision-making (1-5 seconds), the level of risk is zero, but with many elements to remember (Ureña & González, 2006). In short, setting is the action in which decision-making is more relevant, with more options to consider. So, it is recommended the decisional training of the setter, enabling tasks with more than two possible options to choose.

Finally, in the present study, the attack action it is moderately associated with the attack performance, with and a low dependency level between them. Similar results were obtained in the study developed by Claver et al., (2015), with players of the Extremadura league, U-16 category. On the other hand, the level of dependency can suggest that there are other variables that may affect performance. Nevertheless, in a study conducted by Gil-Arias et al. (2016), also in U-16 volleyball players, decision making in the attack action does not correlate with performance. Authors justify the results based on the reduced technical level of the players.

From the perceptive-decisional point of view, the attack has a medium level of difficulty, players have a short time to decide, and a high number of stimuli. In addition, technically, players must get a correct space-time structuring. They must take into account both the direction and speed of the ball and at the same time, reading the opponent block and defense (Ureña & González, 2006). In addition, the physical demands to perform this action are very high. Therefore, the attack decisional work in training must be oriented to the opponent's block

and defense, in order to correctly decide in the different game situations that arise in competition.

The results of our study show that decision-making in the actions of reception, setting and attack are associated with performance in U-19 male volleyball. In this way, it can be assumed that better decisions may improve performance (Hepler & Chase 2008), revealing the possible linear relationship between both variables (Hastie et al., 2009, Iglesias et al., 2005).

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