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COGNITIVE AND MOTIVATIONAL VARIABLES AS PREDICTORS OF PERFORMANCE IN GAME ACTIONS IN YOUNG VOLLEYBALL PLAYERS

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ABSTRACT

The main aim of this research was to analyze the level of prediction of different motivational and cognitive variables on performance in game actions, considering the ranking obtained by the teams at the end of the season. The study sample was composed of 134 Under-16 (male and female) volleyball players (M: 14.82; SD: .89) who compete in a regional league (Extremadura), and were divided into four groups according to the classification. The study variables were: motivational (basic psychological needs and motivation), cognitive (procedural knowledge and decision-making), and performance in game actions. The data research techniques used involved three questionnaires: Spanish version of Sport Motivation Scale by Núñez et al., (2006), Motivational Mediators Scale by González-Cutre et al. (2007) and Procedural Knowledge Questionnaire (Moreno et al., 2013); the systematic observation of game actions for decision-making (GPAI, Oslin et. al, 1998) and performance analysis (FIVB, Coleman, 1975). The results showed that cognitive and motivational variables acted as predictors of performance in players from top teams (1st and 2nd). In the other teams (from 3rd to 8th), only cognitive variables acted as predictors of players' performance. The Self-Determination Theory and the Theory of Information Processing in Sports were used as theoretical framework underpinning the study. These results are discussed on the basis of works that highlight the need and importance of a joint action by the coach on those variables that determine players' performance.

Key Words: motivation, cognition, performance, ranking, training stages, volleyball

RESUMEN

El objetivo principal de esta investigación fue analizar el nivel de predicción de diferentes variables cognitivas y motivacionales sobre el rendimiento en las acciones de juego, considerando el puesto obtenido en la clasificación por los equipos. La muestra del estudio estuvo compuesta por 134 jugadores (M: 14.82; DT: .89) de la liga extremeña cadete de voleibol, y dividida en cuatro grupos en función de la clasificación obtenida por los equipos al final de la temporada. Las variables fueron: variables motivacionales (necesidades psicológicas básicas y motivación), variables cognitivas (conocimiento y toma de decisiones) y el rendimiento en las acciones de juego. Las técnicas de recogida de datos empleadas fueron los cuestionarios: Escala de Mediadores Motivacionales (González-Cutre et al., 2007), versión al español de la Sport Motivation Scale (Núñez, Martín-Albo, Navarro, & González, 2006), Cuestionario de Conocimiento Procedimental (Moreno et al., 2013), y la observación sistemática de las acciones de juego para la toma de decisiones (GPAI, Oslin, Mitchell, & Griffin, 1998) y el rendimiento (FIVB, Coleman, 1975). Los resultados mostraron que las variables cognitivas y motivacionales actuaron como predictoras del rendimiento en los jugadores de los equipos mejor clasificados (1os y 2os). En el resto de equipos, únicamente las variables cognitivas actuaron como predictoras del éxito del deportista. La Teoría de la Autodeterminación y la Teoría del Procesamiento de la Información en el deporte sirven como marco teórico que sustenta el estudio. Estos resultados se discuten en base a trabajos que destacan la necesidad y la importancia de la actuación conjunta por parte del entrenador en aquellas variables que determinan el rendimiento del jugador.

Palabras clave: motivación, procesos cognitivos, rendimiento, clasificación, iniciación deportiva

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INTRODUCTION

Traditionally, the study of the key factors of sport expertise has been carried out in isolation. The research on emotional, cognitive, tactical and physiological variables has been made independently and not being tackled in a joint study, despite its interactive nature in the sporting context (Janelle & Hillman, 2003). Currently, the extreme rationalist point of view, that considered cognition and emotion and diametrically opposed entities, has been relegated (Mayer, Roberts, & Barsade, 2008). In addition, numerous investigations support the special interests of all cognitive and emotional variables as determinants of sports performance, one of the main purposes of this study (McCarthy, 2011).

A key objective in the study of sports psychology has been trying to control the emotions of sport and produce favorable conditions for practice. So, it has been studied and taken as reference variables such as anxiety, motivation or cohesion, comparing performances of athletes who have achieved sporting success with regard to those who have not succeeded (MacNamara, Button, & Collins, 2010).

The literature highlighted the special relevance of the motivational process, identifying motivation as a key element in achieving athletic performance. Motivation is the most important and immediate determinant of human behavior, then it awakens, energizes, directs and regulates it, making it a psychological mechanism that governs the direction, intensity and persistence of behavior. It also increases the commitment and adherence to sport, which is relevant to obtain optimal performance (Sage, Kavussanu, & Duda, 2006).

In this sense, the hierarchical model of Vallerand (Vallerand, 1997, 2001) has become over the years the main theory in explaining the motivation in the field of sport and physical exercise (McCarthy, 2011). Built with the aim of improving and linking the constructs of the Self-Determination Theory, the hierarchical model of Vallerand rests on the satisfaction of basic psychological needs (autonomy, competence and relatedness) to explain the intrinsic and extrinsic motivational processes of players. A great amount of studies have been based on this model in different contexts (physical education, physical activity and health or sport) to demostrate the relationship between motivation and a set of consequences among which is, ultimately, performance. In this way, the consequences can be affective, cognitive and/ or behavioral (Adie, Duda, & Ntoumanis, 2008; Vlachopoulos, Ntoumanis, & Smith, 2010).

A great amount of research studies point out to the importance of the cognitive processes that underlie sport expertise (Williams, Ford, Eccles, & Ward, 2011). In this study, as cognitive consequences, we include procedural knowledge and decision-making of players. Procedural knowledge refers to knowledge structures stored in memory that athletes use during the game

situation (Abernethy, Thomas & Thomas, 1993). The decision-making process refers to the interpretation of the information obtained through perception and its suitability for a selection of an effective response (perceptive-decisional plot, McPherson & French, 1991; Thomas, 1994). The study of cognitive processes has also been made in isolation and has focused on these two variables (Philipps, Davids, Renshaw, & Portus, 2010). Investigations showed the relationship between procedural knowledge and response selection with performance different levels of expertise in sport (volleyball: Moreno, Moreno Ureña, García-González, & Del Villar, 2008; tennis: Del Villar García-Gonzalez Iglesias, Moreno, & Cervelló, 2007; basketball: Del Villar, Iglesias Moreno Fuentes, & Cervelló, 2004; baseball: McPherson & McMahon, 2008; or soccer: González-Víllora García, Pastor, & Contreras, 2011).

The main reason to traditionally choose for monodisciplinary positions in the expert study domain has been the absence of a strong multidisciplinary theory as a conceptual framework. From the sports psychology it has often neglected to study the decisional process (Araújo, 2011). However, the role of cognitive processes is essential, as the subjects do not produce emotional responses if relevant stimuli (Ekman & Davidson, 1994; Lazarus, 2000) can not be perceived. It is necessary to highlight the importance of metacognitive factors for achieving performance, exposing the relationship between cognitive and emotional factors (Jiménez & López-Zafra, 2009; Ward, Hodges, Starkes, & Williams, 2007).

In most developed sport psychology studies that have attempted to relate the motivational variables with performance, it has been used as a performance indicator an indirect measure, as the perception of the player (García-Mas et al., 2011; González & Ortín, 2010; Poizat et al., 2013). An important contribution of this work is to measure performance through the objective and systematic observation of game actions with an internationally accepted system (FIVB, Coleman, 1975). In this regard, the combination of observational methodology, as previous studies (Palao, Manzanares & Ortega, 2015), with the use of questionnaires can be a progress in research to determine which variables affect the real performance, not their perception of performance (Anguera et al., 2014).

Therefore, the main aim of this research was to analyze the level of prediction of different cognitive and motivational variables on performance in volleyball, considering the classification obtained by the U-16 teams of the Extremadura volleyball league. This more ambitious and complex approach, that include different variables that determine performance, will give us a more complete view of the road to sporting excellence.

The hypothesis to be tested in this research are: (I) the cognitive variables act as predictors of performance regardless of the position obtained by teams

in classification; (II) the motivational variables act as predictors of performance in the top teams.

METHOD

Participants

The study sample consisted of a total of 134 subjects (69 boys and 65 girls). The age of participants ranged from 12 to 16 years (M: 14.82; SD: 0.89). Data of the 16 teams (8 male and 8 female) participants in the U-16 category volleyball league Extremadura were collected. The sample was divided into four groups (with four teams each, two male and two female) according to the classification given by the teams at the end of the season. The first group consisted of the first two female classified and the first two male classified teams, the second group by the third and fourth ranked, the third group included the fifth and the sixth ranked teams and fourth group comprised seventh and eighth classifieds. In table 1 descriptive statistics by performance groups are showed.

TABLE 1
Sample distribution depending on the classification.

Group	N	M (age)	SD (age)
Group I (1th y 2th ranked)	38	15.21	.68
Grupo II (3th y 4th ranked)	33	15.02	.75
Grupo III (5th y 6th ranked)	29	14.74	.79
Grupo IV (7th y 8th ranked)	34	14.29	1.05

Measure

Motivation. The validated Spanish version of Nuñez et al., (2006) of the Sport Motivation Scale (SMS: Pelletier, Fortier, Tuson, Briere, & Blais, 1995) was used to measure motivation. The scale consists of 28 items taking into account the continuous three types of motivation: intrinsic, extrinsic, and amotivation. The instrument begins with the statement "I strive to participate and practice my sport...", and has a Likert response scale ranging from 1 (strongly disagree) to 5 (strongly agree). Examples of items for each of the subscales are: "For the pleasure I feel when I learn training techniques that had never been done before" (intrinsic motivation); "Because it allows me to be recognized by the people around me" (extrinsic motivation); "I used to have good reasons, but now I wonder if I continue" (amotivation). The factors indicate adequate levels of reliability, exceeding .70 (Nunnally & Bernstein, 1994), observable in the values of Cronbach's alpha coefficient (.85 to .71 for intrinsic motivation and extrinsic motivation). Except for the amotivation factor (.67), although showing a lower reliability than recommended, due to the small

number of items (three items), internal consistency may be marginally accepted (Hair, Anderson, Tatham & Black , 1998).

Basic psychological needs. Motivational Mediators Scale in Sport (EMMD) created by González-Cutre et al. (2007) has been used to measure the satisfaction of basic psychological needs in the sport context. Preceded by the phrase: "Your impression of the training is...", the responses were collected in a Likert scale of 5 points, where 1 corresponded to totally disagree and 5 to totally agree. It consists of 23 items with three dimensions, of which eight items measured autonomy (e.g. "let me make decisions"), seven items measured competence (e.g. "efficiently I run the exercises in my program of activities") and the remaining eight items measure relatedness (e.g. "I really like the people I train"). The Cronbach's alpha values for each of the factors were: autonomy (73), competence (0.76) and relatedness (0.84).

Procedural knowledge. The procedural knowledge questionnaire (PKCV; Moreno et al., 2013), created from the section of the original questionnaire of McGee and Farrow (1987), was used to measure procedural knowledge. It consists of 24 multiple choice questions with three possible answers, of which only one is correct. It reflects questions about the different tactical situations or phases existing in volleyball. The value of consistency of the instrument was .79.

Decision-making. The Game Performance Assessment Instrument (GPAI) developed by Oslin, Mitchell and Griffin (1998) was the instrument used to measure decision-making. It has been used to observe and encode sporting actions that demonstrate the individuals' ability to solve tactical problems. Of the seven categories in the original instrument category "decision-making" was used, because it defines the full extent analyzed variable. Were recorded by observing all the serve, defense, setting and attack actions, assigning the value 1 to the appropriate decisions, when they met the established criteria, and the value 0 to inappropriate decisions, which did not met the established criteria (Moreno, Del Villar, García-Gonzalez, Gil, & Moreno, 2011; Moreno et al., 2011; Moreno, Moreno, Ureña, García-González, & Del Villar, 2008). The observation of the variable decision-making was made by a single observer, with knowledge in volleyball and experienced in this task. The development of the same observation twice, with a time difference of ten days, brought Cohen Kappa values of intraobserver reliability of .82 and .83. (Values above .81 to provide a good match or nearly complete, Landis and Koch, 1977).

Performance. The observation of performance was done by the observing system of the International Volleyball Federation, FIVB (adapted from Coleman, 1975). It is a tool developed by the International Volleyball Federation, accepted and applied in numerous investigations in volleyball (Fernández-Echeverria et al., 2015; Quiroga et al., 2010). The instrument has a scale where a value of 0-4 for each action, where 0 represents point for the opponent and 4

the successful performance of the action. The observation of the variable decision-making was made by a single observer, with knowledge in volleyball and experienced in this task. The development of the same observation twice, with a time difference of ten days, brought Cohen Kappa values of intraobserver reliability of .88 and .89.

Procedure

Data collection occurred in places of training and competition of the 16 teams participating in the investigation. We contacted first with the Extremadura Federation delegates and volleyball teams. The principal investigator recorded the matches and provided questionnaires to the participants reporting how to fill them and resolve questions that appear during the process.

Both coaches and parents of the players were informed of the investigation, giving their signed for recording matches and collecting data through questionnaires consent. The investigation was performed according to the rules of the Research Ethics Committee of the University of Extremadura (2010), for the participation of the players in the study and data collection.

Statistic analysis

SPSS 19.0 (SPSS Inc., Chicago, IL, USA) was used as computer support for the analysis of the data collected. Measures of Asymmetry, Kurtosis, Kolmogorov-Smirnov with Lilliefors correction verified that the data distribution was normal, leading to the use of parametric statistics.

Initially, the reliability values of questionnaires were obtained (Hair et al., 2013). Subsequently, a descriptive analysis of the data, means and standard deviations were obtained. Finally, a regression analysis by qualifying groups in order to determine the variables that act as determinants of performance depending on the position obtained by the teams in classification was carried out.

RESULTS

Descriptive statistics and reliability analysis

Table 2 shows descriptive statistics of the variables and reliability analysis.

TABLE 2
Descriptive statistics and reliability analysis.

	M	SD	α
Motivation			
Intrinsic motivation	4.1	.71	.85
Extrinsic motivation	3.36	.72	.71
Amotivation	1.95	.93	.67
Basic Psychological needs			
Relatedness	4.37	.62	.84
Autonomy	2.84	.72	.73
Competence	4.06	.56	.76
Procedural knowledge	12.82	3.88	.79
Decision-making	54.9	.73	-
Performance in game actions	2.02	.73	-

Regression Analysis

To determine the variables that predicted players' performance, a linear regression analysis was performed. We consider as the dependent variable the performance in game actions and as predictor variables: block 1, cognitive variables (knowledge and decision-making); block 2, basic psychological needs (autonomy, competence and relatedness); and block 3, motivation (intrinsic, extrinsic and amotivation). The introduction of the variables in the three blocks was performed following the hierarchical model of Vallerand background, motivational process and dependent variable, performance (Vallerand 1997, 2001). To include these variables, we found that the statistical collinearity (tolerance <.10 and VIF <8) showed that variables were not collinear. To analyze the level prediction considering the final ranking, four regression analysis were carried out, one for each of the four resulting groups.

TABLE 3
Coefficients of performance in game action prediction in group I.

	Beta	R square	t	Sig.
Model 1		.307		
Knowledge	-.019		-.137	.892
Decision-making	.552		3.906	.000
Model 2		.417		
Knowledge	-.021		-.158	.876
Decision-making	.538		3.903	.000
Relatedness	-.149		-.999	.325
Autonomy	.146		.987	.331
Competence	.289		1.941	.041
Model 3		.566		
Knowledge	-.003		-.025	.980
Decision-making	.543		3.991	.000
Relatedness	-.051		-.343	.734
Autonomy	.188		1.293	.206
Competence	.287		2.097	.045
Intrinsic motivation	.185		1.051	.302
Extrinsic motivation	-.393		-2.598	.015
Amotivation	.320		2.222	.034

TABLE 4
Coefficients of performance in game action prediction in group II.

	Beta	R square	t	Sig.
Model 1		.229		
Knowledge	.432		2.676	.012
Decision-making	.260		1.612	.038
Model 2		.288		
Knowledge	.448		2.470	.020
Decision-making	.314		1.866	.043
Relatedness	.068		.288	.775
Autonomy	.224		1.244	.224
Competence	-.087		-.327	.746
Model 3		.326		
Knowledge	.410		2.003	.057
Decision-making	.327		1.827	.080
Relatedness	.029		.105	.917
Autonomy	.115		.534	.598
Competence	-.090		-.300	.767
Intrinsic motivation	.020		.096	.924
Extrinsic motivation	.214		1.069	.296
Amotivation	-.070		-.363	.720

TABLE 5
Coefficients of performance in game action prediction in group III.

	Beta	R square	t	Sig.
Model 1		.650		
Knowledge	.408		4.065	.000
Decision-making	.683		6.808	.000
Model 2		.671		
Knowledge	.423		3.792	.001
Decision-making	.677		6.469	.000
Relatedness	.076		.609	.548
Autonomy	-.010		-.090	.929
Competence	-.159		-1.399	.175
Model 3		.715		
Knowledge	.474		4.133	.001
Decision-making	.660		6.277	.000
Relatedness	.118		.724	.477
Autonomy	-.076		-.589	.562
Competence	.049		.295	.771
Intrinsic motivation	-.167		-1.264	.221
Extrinsic motivation	-.048		-.306	.763
Amotivation	.294		1.869	.076

TABLE 6
Coefficients of performance in game action prediction in group IV.

	Beta	R square	t	Sig.
Model 1		.448		
Knowledge	.172		1.216	.233
Decision-making	.593		4.205	.000
Model 2				
Knowledge	.144		.964	.343
Decision-making	.655	.485	4.298	.000
Relatedness	-.128		-.803	.429
Autonomy	-.132		-.803	.367
Competence	.008		.053	.958
Model 3		.518		
Knowledge	.160		.855	.401
Decision-making	.728		4.313	.000
Relatedness	-.171		-.870	.393
Autonomy	-.154		-1.029	.313
Competence	-.126		-.546	.590
Intrinsic motivation	-.013		-.055	.957
Extrinsic motivation	.246		1.134	.268
Amotivation	.044		.222	.826

In Tables 3, 4, 5 and 6 we can observe how only in group I (the top ranked teams) the three blocks of variables predict more than 10% of the variance. However, in groups II, III and IV (low ranked teams) only cognitive variables predicted performance, not acting motivational variables as predictors.

In group I, of the top ranked teams, the three blocks of variables introduced in the regression analysis predicted performance in game actions with a total of 56.6% of the total variance. The cognitive variables block, with 30.7%, is the main predictor of performance. The introduction of the basic psychological needs explained 11.0% of the total variance, while the motivation block accounted for 14.9% of the explained variance. However, in groups II, III and IV, where teams ranked from 3rd to 8th, only the group of cognitive variables act as predictor of performance. Motivational variables fail to explain in any of these groups over 10% of the total variance.

DISCUSSION

There are many factors that influence the formative process of athletes in their way to expert performance (Janelle & Hillman, 2003). Traditionally, the study of these factors (technical, physical, cognitive and emotional) was performed in isolation, while numerous studies highlighted the need for multidisciplinary studies (Ward et al., 2007). Considering studies that confirm the influence of cognitive and motivational processes on performance (Zeelenberg, Nelissen, & Pieters, 2008), the objective of this research was to analyze the level of prediction of different cognitive and motivational variables on performance in game actions, and taking into account the classification of the U-16 teams in the Extremadura volleyball league.

The first hypothesis of the study argued that *cognitive variables will act as predictors of performance* regardless of the position obtained by the teams in classification. The results confirmed this hypothesis, as the cognitive variables acted as predictors of performance in each of the four qualifying groups, reflecting the importance of cognitive skills in sports performance in team sports (Thomas, 1994; García-González et al., 2014; McMahon & McPherson, 2009).

An appropriate level of procedural knowledge facilitates the development of tactically appropriate decisions by players that, together with the realization of adequate execution, determine the performance in game actions (Del Villar, Iglesias, Moreno, Cervelló, & Ramos, 2003), reinforcing the need for optimization. So, expert players often show greater level of knowledge and quality in decision-making compared with less experienced players (McPherson & McMahon, 2008). In this regard, expert players, based on their perceptual-cognitive skills, have a higher declarative and procedural knowledge than players with less experience. Furthermore, a greater number of concepts in knowledge and links between these concepts, being more hierarchical structure and accessible knowledge. Therefore, they are faster and more accurate in their cognitive process, providing solutions to the problems in a more appropriate and creative way, representing them in a more complex

way and using different ways of solving it. However, less experienced players, solve problems taking into account less complex features, offering simpler solutions (Moran, 2009). It is also highlighted that in the last three groups (low ranked) level of explanation that provide cognitive variables is very high. Volleyball coaches in formative stages should influence the cognitive aspects when planning training, to ensure a minimum level of success in their athletes.

The second hypothesis argued that *the motivational variables will act as predictors of performance only on the top ranked teams*. The results confirmed the second hypothesis. Only for the first group (the two top ranked teams) are shown motivational variables as predictors of performance, with more than 10% of the total variance. They have not been found research studies linking motivational and cognitive variables as predictors of performance in game actions in formative stages (Claver et al., 2015), less attempting to distinguish the level of prediction based on the final ranking obtained by the team. However, numerous studies have shown the importance of the motivational process for performance in high performance sport (McCarthy, 2011; Ruiz Sanchez Duran, & Jimenez, 2006). It is widely believed that a certain level of expertise, the differences between players are explained only through the psychological component, confirming the existence of a common psychological profile to high-level athletes (Arruza, Balagué, & Arrieta, 1998), given their greater ability to understand, recognize and manage their emotions, allowing them to improve their athletic performance (Lane et al., 2009). Thus, we can interpret that only the top ranked teams, in which the cognitive and technical aspects are more developed and/ or stabilized, the motivational factors become relevant in predicting performance. We associate the low prediction of motivational factors in the other groups to high technical complexity and the high cognitive requirements volleyball (Costa, Ferreira, Junqueira, Afonso & Mesquita, 2011; Thomas & Thomas, 1994). As individuals proceed to the upper echelons of sports, differences in physical and physiological characteristics appear less likely to discriminate, while the importance of other components is magnified (Causer and Williams, 2013).

The high technical demand for execution in volleyball (Costa et al., 2011), coupled with the significant cognitive demands of the sport, dealing various elements of the game context and respond in time deficit and unable to retain the ball (Thomas & Thomas, 1994) may be more critical to the success of players in the formative stages than motivational factors (Thomas, 1994). In formative stages, players have not fully mastered and automated execution of the game actions, so there are many technical and performance differences between the players of the teams. It seems more important to performance in game actions that players are able to adapt to temporary deficit of game actions, to position themselves correctly in the pitch, to find a free area on the other

team and have the tactical skills necessary to send the ball to that "free space", than to feel more satisfied their basic psychological needs and to be more intrinsically motivated (Jäger & Schöllhorn 2001).

In this study the motivational variables do not predict performance in the game actions in the last three qualifying groups. Nevertheless, we must stress the importance of motivational process to ensure enjoyment and commitment to sport, essential aspects in the process of sports training (García-Mas et al. 2010).

Moreover, we note that most studies use the concepts perception of ability and perception of performance the player himself or coach (García-Mas et al, 2011; González & Ortin, 2010; Poizat et al., 2013). In our study we used the observation of game actions as an indicator of performance, and this is a more objective measure of performance than the perception of the player himself or coach. The differences between the values of the perception of performance and the actual performance of the athlete are evident in the literature. So, Macbeth and Kortada-Kohan (2008) studied the relationship between perceived performance and the actual performance, analyzing the appearance of the effects of overconfidence (overestimation of subjective performance) and underconfidence (underestimation of subjective performance), and making clear the income disparity when an objective and a subjective measurement.

The coaches in volleyball formative stages, whose players showed technical stabilized patterns, manifested in a high level of play, should influence the joint manipulation of cognitive and motivational variables, since the results of the regression analysis support the conclusion that both variables are the determinants of performance into top ranked teams. On the other hand, coaches of lower performance teams, whose players have more technical lacks should primarily develop the cognitive aspects and try to stabilize the technical patterns of his players in order to improve performance, but considering motivational variables that are essential to ensure enjoyment, continuity in practice and the future performance of their players (García-Mas et al. 2010; Manzanares, Ortega & Palao, 2015).

Is a prospective of this work to increase the study sample, even of other categories in order to confirm the Hierarchical Model of Motivation Vallerand (Vallerand, 1997, 2001) in its entirety through a structural equation model. These descriptive-correlational works represent the starting point for the design of experimental studies with intervention programs that allow establish causality in such relationships.

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