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ORIGINAL

INDIVIDUAL DEFENCE IN HANDBALL: INFLUENCE OF TASK CONSTRAINTS

DEFENSA INDIVIDUAL EN BALONMANO: INFLUENCIA DE LOS CONSTREÑIMIENTOS DE LA TAREA

Flores-Rodríguez, J.[1]; Ramírez-Macías, G.[2]

[1] PhD in Physical Activity and Sports Sciences. University of Seville. HUM962 Research Group. Sports and Society (Spain) josefloresrodriguez@live.com
[2] Full Professor. Department of Physical Education and Sports. University of Seville (Spain) grm@us.es

Spanish-English translator: Víctor Gutiérrez Martínez, victor@idiomasleon.es

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ABSTRACT

The aim of this study was to analyze the influence of certain task constraints, on the learning of defensive handball skills. By applying the observational methodology and through the use of an *ad hoc* observation instrument, the behaviors performed by 14 players (M=14,6) were registered over six sessions, while they played 18 games in a small-sided game situation using both teams an individual system defense. Matches were played under the influence of three task constraints and to study their influence on the behavior of the players, it was used the polar coordinate technique. It was found that the prohibition of the bound facilitates the defense of clearing out, whereas the obligation of getting and passing the ball in movement enables the defense of faints, as well as, the realization of steals, helps and follows to another player. These results can help coaches optimize their training programs.

KEY WORDS: handball, non-linear pedagogy, constraint, small-sided games

RESUMEN

El objetivo del presente trabajo fue analizar la influencia que ejercen determinados constreñimientos o limitaciones de la tarea en el aprendizaje de habilidades defensivas en balonmano. Empleando un diseño observacional y mediante el uso de un instrumento de observación *ad hoc*, se registraron los comportamientos realizados por 14 jugadores (M=14,6) a lo largo de seis sesiones, mientras disputaron 18 partidos en situación de juego reducido, empleando ambos equipos un sistema defensivo individual. Los partidos se disputaron en presencia de tres constreñimientos, y para estudiar su influencia en los comportamientos de los jugadores, se utilizó la técnica de coordenadas polares. Se encontró que la prohibición del bote facilita la defensa de desmarques, mientras que la obligatoriedad de recibir y pasar en movimiento facilita la defensa de fintas, interceptaciones, así como, la realización de doblajes y deslizamientos. Estos resultados pueden ayudar a los entrenadores a optimizar sus programas de entrenamiento.

PALABRAS CLAVE: balonmano, pedagogía no lineal, constreñimiento, juegos reducidos

1 INTRODUCTION

In team sports, such as handball, sporting actions take place in environments of great uncertainty (multiple interactions between teammates and opponents, under the influence of numerous factors that condition each other), where it is unlikely that players will face the same situation twice (Seirul·lo, 2017; Varela, Ureña, Ruiz & Alarcón, 2010). The uncertain and unpredictable nature of the actions, together with the little time available for their execution, emphasize, on the one hand, the importance of the player developing his capacity to adapt and act in tremendously changing environments and, on the other hand, question the existence of motor programmes and mental representations previously stored in the brain, as is assumed in traditional teaching models (Balagué, Torrents, Pol, & Seirul·lo, 2014). In recent years, various studies, carried out in the field of neuroscience, seem to confirm this approach by demonstrating how certain motor actions are neither planned (Soon, Brass, Heinze, & Haynes, 2008), nor inhibited by consciously elaborated decisions (Filevich, Künh, & Haggard, 2013). These findings suggest that the process of training collective sports actions is predominantly implicit and unconscious, rather than explicit and conscious as conceived in traditional methodologies (Balagué et al., 2014). In traditional methodologies, excessively analytical and structured training tasks predominate (Robles-Rodríguez, Giménez & Abad, 2011), which bear little resemblance to the changing contexts of the match; this fact has been, and continues to be, the object of debate as doubts arise regarding the transfer of the learning acquired in this type of task (Chow & Atencio, 2014; Nathan, Salimin, & Shahril, 2017; Seirul·lo, 2017).

Thus, in recent years, methodological proposals, such as non-linear pedagogy, which differ substantially from traditional teaching methods, are emerging strongly. Non-linear pedagogy offers researchers a powerful theoretical framework for the study of team sports (Chow, Davids, Hristovski, Araújo, & Passos, 2011); at the same time that, for physical education coaches and teachers, it is consolidated as a firm alternative to traditional methods, offering better results in the training of team sports skills (Clark, Mcewan, & Christie, 2018). This pedagogy, based on postulates of general systems theory and ecological psychology, conceives the teaching-learning process in terms of functional and adaptive relationships between a system (athlete) and its environment (learning task or real game situation), instead of pretending that the athlete perfectly reproduces a certain technical execution model (Araújo & Davids, 2011; Renshaw & Chow, 2018).

Specifically, it considers that learning emerges as a consequence of the active exploration of the task by the player, because as he acts, he directly perceives his affordances or possibilities of action that a given situation presents for him without the need for mental representations (Passos, Araújo, Davids, & Shuttleworth, 2008). The player and team, while participating in the task, modify and/or create patterns of behaviour that help them to successfully resolve the constraints or present limitations (Araújo, Davids, & Hristovski, 2006; Chow & Atencio, 2014).

In this regard, it is important to emphasize that constraints play an essential role in non-linear pedagogy, since by reducing the number of behaviours available to the athlete, they favour the realisation of certain technical and tactical skills, to the detriment of others (Balagué, Pol, Torrents, Ric, & Hristovski, 2019). In particular, there are three main types of constraints: those of the environment (weather conditions, presence of spectators, etc.), those of the player or team involved (level of skill, anthropometric and functional characteristics, etc.) and those of the task (objectives, rules, materials used, play space, etc.) (Correia, Carvalho, Araújo, Pereira, & Davids, 2018).

The action on the constraints of the task (selection, modification and/or elimination) is considered as the main tool of the coach to provoke the emergence of certain behaviours that facilitate the achievement of the proposed learning objectives (Cantos and Moreno, 2019). In order to refine the process of manipulation and selection of the constraints to be introduced in the tasks, the coach faces a double challenge: on the one hand, he must know the influence of the constraints on the behaviour of his players and, on the other hand, he must estimate the possible actions they will carry out to successfully solve the task (Renshaw & Chow, 2018). Therefore, it is important to identify both the general trends of behaviour (patterns of behaviour that are common in certain situations), as well as the limitations and/or specific needs that present their players at the individual, group and collective level.

In order to know the influence exerted by certain constraints of the task, in recent years there has been a proliferation of studies focused on team sports such as rugby (Cantos & Moreno, 2019), football (Ric et al., 2017), basketball (Esteves et al., 2015) or volleyball (Paulo, Davids, & Araújo, 2018), which have

provided valuable information for the work of researchers and coaches. However, it is still necessary to deepen on this key aspect: to know the influence of the constraints of the task on the behaviours performed by athletes during training, so that we can answer the following questions: What are the most relevant constraints of the task to facilitate the acquisition of certain skills? How do we know that the manipulation of certain constraints of the task makes it easier or more difficult for players to perform certain behaviours? Does the presence of a certain constraint affect all players equally? (Correia et al., 2018).

To the previous questions is added the fact that there is no empirical knowledge about the implantation of the postulates of non-linear pedagogy in the learning of the individual and collective skills of handball. For all these reasons, the aim of this study is to know the influence exerted by certain constraints, applied in handball matches played in a modified game situation, in the performance of individual defensive skills (assignment of one-on-one coverage, interception, covering in the goal line, covering a player with a ball who tries to feint, ball dispossession in a bounce and blocking) and collective defensive skills (sliding, change of opponent and double dribble), evaluating whether this influence is expressed in the same way in all players. Obtaining evidences on this subject could help the optimisation of training programmes, favouring that coaches can select the constraints of the most relevant task for the achievement of the proposed learning objectives and avoiding that this selection is based exclusively on intuition or subjective knowledge (Renshaw & Chow, 2018).

2 MATERIAL AND METHODS

The observational methodology is especially appropriate for the study of the behaviour of the players in the real game situation (Aragón, Lapresa, Arana, Anguera, & Garzón, 2016). According to the proposed research objectives, we opted for an observational design Follow-up/Idiographic/Multidimensional (F/I/M) (Anguera, Blanco-Villaseñor, Hernández-Mendo, & Losada, 2011). Follow-up, due to the fact that an inter-sessional and intra-sessional analysis was made which provided information on the frequency of the actions performed; Idiographic, by studying the behaviour of several players who, as part of the same team (system), functioned as a unit; and Multidimensional because different levels of defensive behaviours are studied, both individual and collective.

2.1 PARTICIPANTS

The research project was formulated in accordance with the code of conduct and ethical principles established in the Declaration of Helsinki and the Declaration of Human Rights, obtaining approval from the ethical committee of the University of Seville. There were 14 players who are part of a male cadet handball team, (M=14.6; SD=0.4) which competes in a provincial league in Seville (Spain). The players, with more than four years of previous experience in handball practice (M=4.2 years; SD=0.8), devoted four hours a week to handball practice, distributed in four sessions, plus a match corresponding to the official competition.

The 14 players were distributed in two teams, at a balanced level according to the coach's criteria, which were not modified during the six sessions (two sessions per week) in which the research was carried out. Eighteen matches (three matches per session) were played in a modified game situation. Each match lasted 10 minutes and was played on a pitch 24 metres long and 14 metres wide. The teams competed with 5 players at the same time and used obligatorily an individual defensive system.

2.2 OBSERVATION INSTRUMENT

The observation units were all the defensive sequences of both teams, that is, when the team under analysis is not in possession of the ball. In order to record the defensive behaviours (individual and collective) most relevant to the achievement of the proposed research objectives, an *ad hoc* observational instrument was constructed (Table 1). The observational instrument combined the field format with a system of exhaustive and mutually exclusive categories. This combination makes it possible to take advantage of the strengths of both instruments, on the one hand, the categories system offers theoretical consistency, while the field format brings flexibility when it comes to collecting the diversity of behaviours carried out by the players, allowing a perfect adaptation to the characteristics of the participants (Anguera & Hernández-Mendo, 2013).

Table 1 – Observation instrument used in the study.

Criteria	Categories
Constraint (CON)	Present constraints when the defensive action take place: • The analysed action is developed without the presence of constraints (NCO). • The analysed action is developed with the prohibition of bouncing (NBO). • The analysed action is developed with the obligation to pass and receive the ball running (MVT).
Team (TM)	The defensive action analysed corresponds to the team: • Orange (ORA). • Blue (BLU).
Individual skills in defence (INS)	Individual action performed by the defender responsible for the attacker who ends possession of the ball: • The attacker makes a throw after receiving alone, due to an error in the marking assignment of the attackers without a ball (two defenders mark the same attacker or one defender does not mark anyone) (ERR) • The defender, through interception, gets the ball back after preventing a pass from being completed (ITR). • The defender, by covering on the goal line, opposes an unmarked attacker with the intention of receiving the ball in a good position to score (MSL). • The defender marks a player with the ball who performs a feint action (OX1). • The defender attempts to get the possession of the ball back from an attacker who bounces (RBO). • The defender performs a blocking action on a distant throw (BLC).

	• The defender of the player who throws the ball has come to help a teammate who has been surpassed (HLP).
Collective skills in defence (CLS)	Defensive collaboration, between at least two defenders, during the possession of the ball. • Double dribble to a teammate who has been surpassed (DBL). • Change of opponent: against attackers who collaborate by means of a cross, swap or block (CHG) • Sliding: against attackers who perform a cross, swap or block (SLD). • Other collaboration different from the previous ones (OTH). • There is no collaboration between defenders (NOC).
Finalisation (FIN)	Mode in which the attack ends: • The attack ends with a throw (THR). • The attack ends with the defence getting the ball back (BCK). • The attack ends with a free kick or an interruption in the game, with no change in the possession of the ball (FKI).
Start of the attack (STA)	The analysed defence phase starts after: • Goal kick (GKI). • Free kick or throw-in (KCK). • Ball loss (LOS).

2.3 RECORDING AND ANALYSIS INSTRUMENTS

The recording of the 18 matches was done using a Sony FDR-AX33® camera, located 4 meters high behind one of the goals, ensuring an optimal plane of vision. Once the matches were recorded, the observation instrument was applied by means of the software DARTFISH 5.5®, which acted as a recording and coding tool for all the defenders. Once the behaviours had been coded, the data quality was analysed by calculating the Kappa coefficient using the SDIS-GSEQ 4.0 software package (Bakeman & Quera, 1995). Subsequently, through the program HOISAN 1.2 (Hernández-Mendo, López-López, Castellano, Morales-Sánchez, & Pastrana, 2012), the technique of polar coordinates was applied, which allowed to know the behaviour patterns expressed by the players, to represent them graphically using the application Snowflake 0.2®. Finally, it should be noted that, as a prerequisite for the application of the polar coordinates technique, it was necessary to perform the sequential analysis using the SDIS-GSEQ 4.0 programme.

2.4 PROCEDURE

The 14 players were distributed in two teams, with a balanced level according to the coach's criteria, which were not modified during the six sessions (two sessions per week) in which the research was carried out. 18 matches were played (three matches per session), lasting 10 minutes in a modified playing situation (5 vs. 5, on a pitch 24 metres long and 14 metres wide, with a rectangular area situated 6 metres from the goal) where both teams had to use an individual defensive system. The modified game situations comply with the postulates of non-linear pedagogy in the design of tasks, since, by preserving the structure and essence of the real sport, they allow players to develop individual and collective skills in contexts similar to those of the competition (Chow, Davids, Button, & Renshaw, 2015).

The 18 matches were played under the influence of the three constraints of the task (six matches for each constraint analysed), whose influence on defensive behaviours was analysed in this study. The first six matches were played without the presence of any additional constraint (NCO), the following six matches were played in the presence of the constraint bounce prohibition (NBO) and, finally, the final six matches were played under the influence of the constraint of the task: passing and receiving the ball running (MVT). The coach did not at any time before, during or after the matches provide the players with any information or indications related to the development of the game in order to avoid influencing their behaviour.

The observation and coding of the actions was carried out by two observers, both with the title of national handball coach, previously trained in the use of observation and recording instruments. The quality control of the data from the record at the inter-observer level was carried out using Cohen's Kappa concordance coefficient, obtaining κ = 0.90. The reliability of the intra-observers, considering all criteria together, was higher than 0.93 for both observers. The results obtained can be considered almost perfect according to the classification of Landis & Koch (1977).

3 RESULTS

3.1 POLAR COORDINATE ANALYSIS

The analysis of polar coordinates is a valuable tool that allows to analyse the patterns of behaviour that emerge during the practice of handball (Flores-Rodríguez & Anguera, 2018). As a previous step to its realisation, it is required the calculation of the adjusted residues by means of the application of the sequential analysis. The objective of the sequential analysis is to identify the significant relationships, both at a prospective and retrospective level, between the different behaviours that are analysed, since both the prospective and retrospective perspective must be taken into account in the graphical representation (Gorospe & Anguera, 2000). One of the categories analysed assumes the role of focal behaviour, being considered as generating, "forward" (prospective perspective) and "backward" (retrospective perspective), of the associations with the other behaviours studied, which acquire the role of conditioned behaviours (Tarragó et al., 2017). Through the calculation of the statistic $Z_{sum} = \frac{\sum Z}{\sqrt{n}}$, a powerful data data reduction technique, (Sackett, 1980) we know both the strength of the association, indicated by the length of the vector, and the nature of the same, which can be activation or inhibition, indicated by the quadrant in which it is located. When the association is represented in quadrant I, it indicates a relationship of mutual activation between the focal behaviour and the conditioned one, however, when it is represented in quadrant III, a relationship of mutual inhibition is expressed. The graphical representation in quadrant II indicates that the focal behaviour inhibits the conditioned one, while it is activated by it; inverse situation to that obtained when the association

is located in quadrant IV, because in this case the focal behaviour activates the conditioned one, at the same time that it is inhibited by it (Anguera et al., 2011).

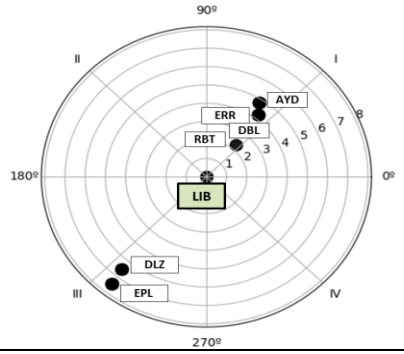
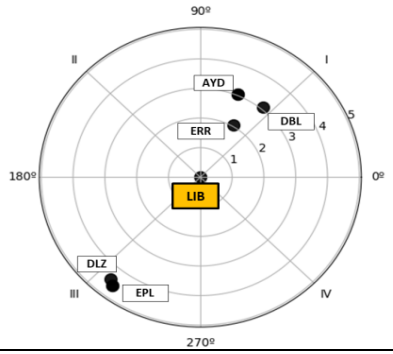
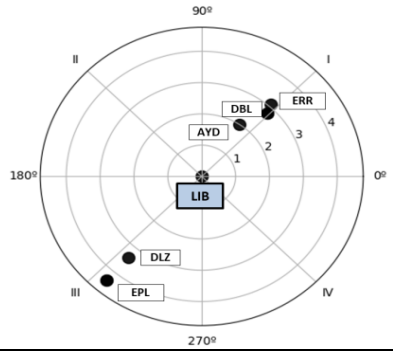
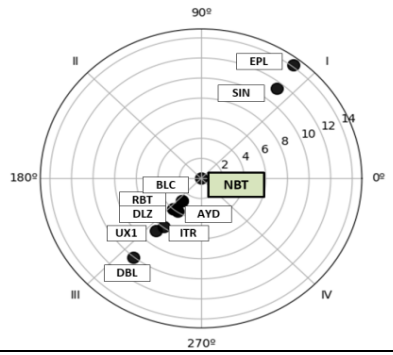
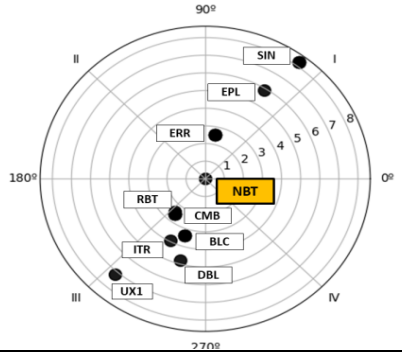
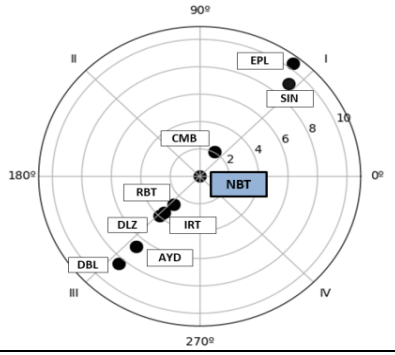
The following sections comment on the significant associations, those with a length > 1.96 ($p<0.05$) represented in the different polar coordinate maps located in table 2. The table consists of nine maps, distributed in three rows and three columns, where the different constraints present in the development of the matches act as focal behaviour; in the first row the behaviours expressed when the matches are developed without the presence of constraints (NCO) are analysed; in the second row when the match is played with the prohibition of bouncing (NBO) and in the third row the behaviours are analysed when it is obligatory to pass and receive the ball running (MVT). As conditioned behaviours, all categories belonging to the criteria will act: individual skills (INS) and collective skills in defence (CLS). Finally, with regard to the columns, the one on the left analyses the behaviour of both teams together; the central one deals with the behaviour carried out by the orange team (ORA), and the one on the right represents the significant associations of the blue team (BLU). The order of mention of the different associations represented will be from greater to lesser intensity.

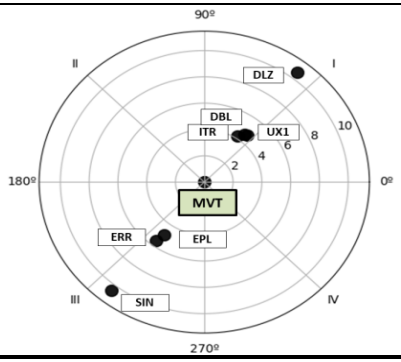
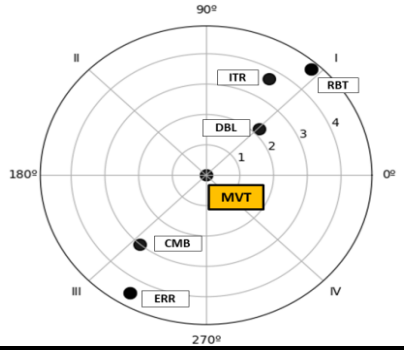
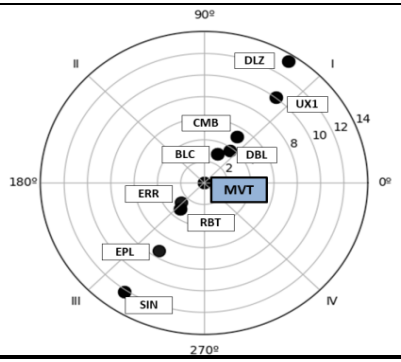
3.2 MATCHES WITHOUT ADDITIONAL CONSTRAINTS (NOC)

In matches played without the presence of any constraint (NCO), the joint analysis of the behaviour of both teams indicates a relationship of mutual activation (Quadrant I) with HLP (the defender of the player who throws the ball has come to help a teammate who has been surpassed), ERR (error in the assignment of marking), RBO (the defender attempts to get the possession of the ball back from an attacker who bounces) and DBL (double dribble to a teammate who has been surpassed). At the same time, there is an association of mutual inhibition (Quadrant III) with the conditioned behaviours MSL (the defender opposes an unmarked attacker with the intention of receiving the ball in a good position to score) and SLD (sliding).

When we analyse the behaviour of both teams separately, we see that the orange team (ORA) has an association of mutual activation with HLP, DBL and ERR and a mutual inhibition relationship with MSL and SLD. On the other hand, the blue team (BLU) shows a reciprocal activation with the conditioned behaviours: ERR, DBL HLP, and mutual inhibition with MSL and SLD.

Table 2 – Polar coordinates maps obtained acting as focal behaviours the constraints introduced in the tasks.

Applied Constraints (CON)	Both Teams Considered Together	Orange Team (ORA)	Blue Team (BLU)
No Rules (NCO)			
Bouncing prohibition (NBO)			

Pass and receive in motion (MVT)			

3.3 CONSTRAINT: BOUNCING PROHIBITION (NBO)

In the defensive actions developed under the presence of NBO constraint, when analysing the behaviours of both teams together, we can observe a reciprocal activation relationship with MSL and NOC (there is no collaboration between defenders) and a mutual inhibition association with: DBL, OX1 (the defender opposes the execution of a feint by the attacker who finishes), ITR (the defender gets the possession of the ball back after preventing a pass from being completed), SLD, HLP, RBO and BLC (the defender performs a blocking action on a distant throw).

In the analysis of both teams separately, the orange team presents a mutual activation association with the behaviours NOC, MSL and ERR and a mutual inhibition relationship with the categories: OX1, DBL ITR, BLC and CHG (change of opponent) and RBO. The blue team, on the other hand, has a mutual activation relationship with MSL, NOC and CHG and a mutual inhibition association with DBL, HLP, SLD, ITR and RBO.

3.4 CONSTRAINT: PASSING AND RECEIVING IN MOTION (MVT)

The influence of MVT constraint, when analysing the behaviours of both teams together, is expressed in an association of mutual activation with the defensive skills: SLD, DBL, OX1 and ITR, at the same time that a relationship of mutual inhibition emerges with: NOC, ERR and MSL.

In the analysis of the behaviours of both teams separately, the presence of the constraint MVT, causes in the orange team a mutual activation with RBO, ITR and DBL and a mutual inhibition with ERR and CHG. However, for the blue team, the same constraint causes a mutual activation with SLD, OX1, CHG, DBL and BLC, at the same time as it presents a mutual inhibition association with NOC, MSL, RBO and ERR.

4 DISCUSSION

The objective of this research was to know the influence of certain constraints, introduced in the development of handball matches played in a modified game situation, in the performance of individual defensive skills (assignment of marking, interception, marking in the shooting line, marking a player with a ball who attempts to feint, dispossession in a bounce and blocking) and collective defensive skills (sliding, change of opponent and double dribble), evaluating whether this influence is expressed equally in all players. By means of the polar coordinates technique, the behaviour of all the players was analysed, on the one hand, in order to know the general tendencies and, on the other hand, those of each team, in order to know their specific tendencies.

Due to the absence of similar studies with which to discuss the results, we will confront the different patterns of behaviour found in the presence of the constraints investigated. First of all, it should be emphasized that, due to the reactive nature of most of the defensive skills analysed, defensive behaviours

are conditioned by the actions performed by the attacking team. For this reason, when matches are played without the presence of any constraint, the attackers mainly use actions with the ball to surpass the defence, to the detriment of getting away from one's marker or changes of positions, a situation that causes the defensive skills RBO, HLP and DBL to be activated, at the same time as MSL and SLD are inhibited. Also, the development of the game without constraints, seems to favour the appearance of quick attacks making difficult the distribution of ERR markings by defenders.

In addition, the bounce prohibition (presence of the NBO constraint) limits the attackers' movements with the ball, a situation that causes the emergence of other behaviours (without ball) to score goals such as unmarks, resulting in a very strong mutual activation association with the individual defensive skill MSL. Likewise, the influence on game development caused by this constraint means that NOC defensive collective skills do not appear.

In matches played under the influence of the MVT constraint, due to the obligatory nature of the attackers to pass and receive in motion, feint actions are favoured while encouraging greater mobility and exchange of the attackers' positions. This style of game provokes the activation of the OX1 and DBL skills to counter feints, at the same time that the collective SLD skill is activated, as a response to the exchange of positions of the attacking players. Also, the MVT constraint, by limiting the available time to make the pass, could explain the appearance in defence of behaviours oriented to the interception of passes (ITR).

With regard to the collective skill of opponent change (CHG), no association of mutual activation has been found with any of the constraints used in this study, this could be due to the fact that the individual defensive system, used by both teams in all matches, offers a poor context for its use.

Keeping this in mind, we can note that the defensive skills performed, individual and collective, are the result of the interaction between the individual constraints (individual characteristics of players and teams) and the constraints introduced in the tasks. This explains the emergence of specific behaviour patterns, according to the group of players to be analysed (Balagué et al., 2019). In this way, the interdependence existing between all the elements present at the moment in which the sporting action is carried out is revealed, since changes in one of these elements lead to changes in the final behaviour of the system (that is, of the player) (Flores-Rodríguez & Anguera, 2018). Therefore, the results obtained show that the manipulation of the constraints of the task can be a powerful tool for the coach when provoking and/or inhibiting the appearance of certain individual and collective behaviours (Cantos & Moreno, 2019; Renshaw & Chow, 2018).

5 CONCLUSIONS

The present study contributes, in part, to cover the need of obtaining empirical knowledge on the influence (facilitation or inhibition) exerted by certain constraints of the task, in the behaviours carried out by the players.

For the participants in this study, it has been demonstrated that there are some constraints more relevant than others for the acquisition of certain behaviours. The use of the MVT constraint facilitates the realisation of the defensive skills SLD, OX1, DBL, ITR, at the same time that makes difficult the appearance of NOC, ERR and MSL. Also, the presence of the NBO constraint has facilitated the appearance of MSL, NOC and has blocked the appearance of DBL, OX1, SLD, ITR, RBO, BLC behaviours. Likewise, the individual defensive system does not favour changes of opponent CHG, as none of the constraints used has activated this collective skill.

Although there are general behavioural trends, specific behaviours also appear in the groups studied. This indicates that the influence exerted by constraints is not the same for all players, emphasizing the need to take care of aspects such as the composition of groups (intra and intergroup level) in the trainings, or the manipulation or selection of constraints specific to each group.

In order to improve the potentiality of the results obtained in this research, it would be recommendable to check the influence of the constraints studied on other participants (players of different age, sex and skill level), as well as on other types of tasks or matches (different number of players per team, different dimensions of the playing field, use of other defensive systems, etc.). Similarly, in view of the explanatory potential of the analysis of polar coordinates, it would be advisable in future researches to study the influence of other constraints on behaviour at different stages of the game.

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