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ORIGINAL

EFFECT OF TRAINING-TASK ORIENTATION IN WOMEN'S FOOTBALL

EFECTO DE LA ORIENTACIÓN DE LAS TAREAS DE ENTRENAMIENTO EN FÚTBOL FEMENINO

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ABSTRACT

The aim of this study was to analyse whether the modification of training tasks, specifically spatial orientation, had consequences on the different parameters that identify training load in women's football. Eighteen female football players participated (*M* = 21.89; *SD* = 6.20) completing two sessions of four tasks each. The tasks were counterbalanced within each session to prevent the effect of order. GPS Polar Team Pro was used to measure physical load and questionnaires were applied to assess mental load. A repeated-measures T-test was conducted to compare the results of each session. The results showed that physical load was higher in tasks with no orientation, and the same occurred with mental load. Therefore, the space in which training tasks are performed is determining in perceived mental load in women's football.

KEY WORDS: professional football, football training, fatigue, mental load.

RESUMEN

El objetivo de este estudio ha sido analizar si la modificación de las tareas de entrenamiento, en concreto la orientación del espacio, tiene consecuencias en los diferentes parámetros que identifican la carga de trabajo en el fútbol femenino. En el estudio participaron 18 jugadoras de fútbol femenino (*M* = 21.89; *DT* = 6.20), que realizaron dos sesiones con cuatro tareas cada una. Las tareas estaban contrabalanceadas para cada sesión para evitar el efecto del orden de las mismas. Se utilizaron GPS Polar Team Pro para medir la carga física y cuestionarios para la carga mental. Para comparar los resultados de cada sesión se llevó a cabo una prueba T de medidas relacionadas. Los resultados muestran que la carga física fue mayor en las tareas donde no hubo orientación, al igual que la carga mental. Por tanto, el espacio en el que se desarrollan las tareas de entrenamiento resulta determinante en la carga mental percibida en fútbol femenino.

PALABRAS CLAVE: fútbol profesional, entrenamiento de fútbol, fatiga, carga mental.

INTRODUCTION

Recent literature has analysed physical load management, but the research that has addressed cognitive load (Alarcón, Castillo-Díaz, Madinabeitia, Castillo-Rodríguez, & Cárdenas, 2018) and, in particular, involving spatial orientation in training tasks (Casamichana, Castellano, Blanco-Villasenor, & Usabiaga, 2012) is scarce. Therefore, the present study aims to analyse the effect of modifying aspects related to training tasks on mental and physical load in women’s football.

Since it was created until nowadays, football has experienced noteworthy evolution (Rodenas et al., 2020). At the beginning, training methodology was based on the scientific paradigm, the different types of skills (technical, tactical, physical and psychological) being expressed individually, and appearing in a mechanistic manner in training (Álvarez Del Villar, 1987). It slowly evolved into a holistic model, where all elements were interrelated. Currently, everything is unified within the training process, its parts composing a whole to create sessions where the different structures are united and interrelated (Seirul-lo Vargas, 2017). Nonetheless, it seems necessary to understand what happens in every player structure in order to optimise that process and to help the athlete achieve appropriate preparation. In this regard, to better control the training process, it needs to be born in mind that several structures exist within the player (conditional, creative, cognitive structure, etc.) (Seirul-lo Vargas, 2017), which can be quantified, controlled and monitored.

Within this process, training load is a variable that can be manipulated to obtain the desired response (Impellizzeri, Marcora, & Coutts, 2019) in the different player structures, the fatigue generated on the player being one of the potential responses. This fatigue produced on the player has been generally studied from a physiological perspective. Nevertheless, recent research has started to widen scope in order to understand it from a psychological point of view (Smith et al., 2018). Therefore, based on the different player structures and the training load, we can quantify the physical and the psychological or cognitive structures, obtaining two types of load: physical and mental load (García-Calvo, 2017).

Physical load can be understood as the different movement stimuli or the general, special and competition training exercises that generate morphological, functional, biochemical and psychological adaptations (Pareja, 2010). Taking this into account, it seems necessary to control this load, which can be divided into two subtypes that affect every player in a different manner: external and internal load. External load is the amount of work performed by the athlete measured regardless of their internal characteristics (Lee, Wallace, & Coutts, 2009; Toscano-Bendala, Campos-Vázquez, Moreno-Arrones, & Sánchez-Núñez, 2018). One example could be the speed reached by a player during a high-intensity effort. To analyse these variables, there are tools that allow for monitoring and objective quantification of this load, such as global positioning systems (GPS; Sánchez-Núñez, Toscano-Bendala, Moreno-Arrones, Martínez-Cabrera, & de Hoyo, 2019). Internal load refers to the physiological stress imposed on the athlete by the task they perform (Halson, 2014). It informs about the player's degree of adaptation to the training process and fatigue recovery (Romero-Caballero & Campos-Vázquez, 2020) and, therefore, it helps adjust the training load (Tapia-López, 2017). To quantify this load, there are currently numerous methods based on the linear relationship existing between heart rate and VO2 max (Lambert & Borresen, 2010).

There are several definitions available to describe mental load. Ceballos-Vásquez et al. (2015) defined it as the cognitive and emotional demands of a specific task. Furthermore, this load depends on various psychosocial and context factors and there are certain variables that can be modified in order to increase or reduce it (García-Calvo, 2017). In particular, there are five types of load that affect mental load: cognitive load, which refers to the cognitive demands of training and is mainly associated with a task's tactical requirements; emotional load, which is one of the main elements that determine mental load and which depends on the emotions produced by a certain situation; socio-affective load, which refers to the interdependence among players during training tasks and to the amount of affective and social load they generate; motivational load, which is related to the level of motivation generated by training tasks on the player and their effect on perceived effort; and, lastly, physical load, which has been explained above. Thus, a higher level of physical demand would be reflected on higher mental load (García-Calvo, 2017).

It seems necessary to consider these constructs when designing training tasks, since we need to know how much load their execution and the subsequent fatigue will impose on the athlete. More specifically, in football, fatigue is defined as the mechanical (strength/power) and physiological decrease in player performance (Barrett, 2017). Moreover, mental fatigue must be taken into account, since it will generate a different kind of fatigue. In this regard, it is defined as a psychobiological state characterised by feelings of tiredness and a lack of energy, and is induced by prolonged periods of demanding cognitive and/or emotional activity (Badin, Conte, & Coutts, 2016).

Besides, in order to design training tasks correctly, it is necessary to understand that the different changes can affect a player's physical and mental parameters. Consequently, to quantify physical and mental load and to manage them properly, it is necessary to know what changes can be made to training tasks and how they will affect players. In this regard, some studies have revealed how these constraints affect players and their potential consequences on the different parameters (Vilar, Araújo, Keith, & Button, 2012).

More specifically, task orientation is one of the constraints that can be used to modify a task. According to this, rate of perceived exertion (RPE) was analysed in players during small-sided games including modifications, and it was found that spatial orientation and the number of players affected perceived task intensity. Situations where orientation was not determined were perceived as more intense compared to those where it was fixed. Furthermore, it was established that task orientation is a relevant variable when designing training tasks, significantly affecting a player's rate of perceived exertion (Casamichana et al., 2012).

Other authors confirmed that adding spatial references to a task reduced the physical demand for players; nonetheless, the number of accelerations increased when a small-sided game was played without reference lines (Coutinho et al., 2017). As regards mental demand, adding reference lines to a task increased the information available to the athlete, increasing the perceptive demands and making it more difficult to make decisions and, therefore, increasing the task mental load (Vaeyens, Lenoir, Williams, Mazyn, &

Philippaerts, 2007). Similarly, Coutinho et al. (2018) found that adding spatial references to a task reduced its entropy value, establishing some regularity in players' movements. Barte, Nieuwenhuys, Geurts, and Kompier (2018) proved that the implementation of a motivational protocol increased players' physical performance, as well as allowed them to prevent performance decrease during the task executed. Furthermore, other recent studies verified that modifying the scoring system of a training task imposed greater mental load, the differences being significant. Thus, the use of this type of rule had different effects on players' physical and mental load (García-Calvo, González-Ponce, Ponce, Tomé, & Vales-Vázquez, 2019).

Thus, considering all the above, the aim of the present study was to analyse whether the modification of training task aspects, in particular spatial orientation, had consequences on the different parameters that identify work load, especially mental load, in women's football. This is deemed interesting because it involves women's football and mental load variables are included. Based on the main aim of the study and according to previous related studies, it was hypothesised that adding orientation to a task would reduce physical and mental load imposed on players.

METHOD

Participants

A total of 18 female football players (*M* = 21.89; *SD* = 6.20) from a team of second national division (group IV) participated in the study. Their mean football training experience was 8.23 ± 2.2 years and they trained three days a week plus one weekly match.

Instruments

Physical load. A Polar Team Pro system (Polar Electro, Finland, 2015) was used to assess the physical load of the training tasks. This technology is based on the combination of signals from different Polar sensors, designed for control and monitoring of physical activity in team sports (Coutts & Duffield, 2010). The variables measured were: mean heart rate (HRM), maximum heart rate (HRMax), mean speed (SM), total distance covered (TD), distance covered per minute (D/min), maximum speed (SMax) and number of sprints (Sprints).

Rate of perceived exertion. The perceived exertion scale (Impellizzeri, Rampinini, Coutts, Sassi, & Marcora, 2004) was used to assess the exertion perceived by players after the different tasks. This scale ranges from 0 to 10, where 0 corresponds to rest and 10 to maximum effort.

Mental load. An adaptation of NASA-TLX questionnaire (García-Calvo, González-Ponce, Ponce-Bordón, Candela, & Leo, 2019) was applied to quantify the mental load imposed by the tasks. In this adaptation, players were requested to assess different aspects: mental demand, physical demand, temporal pressure, satisfaction with own performance, level of effort, frustration and interaction with team mates. Besides, the variable motivation was added. The answers could range from 0 to 100, 0 meaning nothing and 100 maximum demand.

Mental fatigue. Visual Analogue Scale (VAS) was used to determine the mental fatigue. This scale analyses the mental fatigue imposed by a task and has been previously applied to training and research context in football (Smith, Fransen, Deprez, Lenoir, & Coutts, 2017). It allowed for determination of players' level of mental fatigue at a specific moment. The scale ranges from 0 to 100, and the player was requested to indicate the level of mental fatigue imposed by a specific task.

Design and procedure

Firstly, the participants and the team's technical staff were informed about the types of test to be conducted in order to obtain their consent, but not about the aims of the study in order to prevent any effect on result validity. Data were handled according to the privacy, ethics and protection policies of the *American Psychological Association* (2009).

A quasi-experimental and counterbalanced research design was used, consisting of two sessions with four training tasks each, organised according to strategies that determined the aim to be achieved. More specifically, one task contained spatial orientation and another one did not, to prevent the effect of accumulated fatigue across them. The task design was uniform, so that the methodological premises were always respected, the same modifications were applied to all tasks and the same team and participants were involved in each task. Recovery time was 3 minutes between tasks 1 and 2 and 5 minutes between tasks 3 and 4.

The sessions and tasks are described in Table 1.

Table 1. Research design.

Session 1	Session 2
Normal possession (4 vs. 4). One point (goal) is scored every 5 passes. 20m x 20m field. Duration: 5 minutes (T1).	Oriented possession (4 vs. 4). Every team is oriented to attack on one side. A goal is scored by crossing the goal line, in or out of the goal. 20m x 20m field. Duration: 5 minutes (T2).
Oriented possession (4 vs. 4). Every team is oriented to attack on one side. A goal is scored by crossing the goal line, in or out of the goal. 20m x 20m field. Duration: 5 minutes (T2).	Normal possession (4 vs. 4). One point (goal) is scored every 5 passes. 20m x 20m field. Duration: 5 minutes (T1).
Normal possession (8 vs. 8). One point (goal) is scored every 8 passes. 50m x 30m field. Duration: 10 minutes (T3).	Oriented possession (8 vs. 8). A goal is scored by crossing the goal line, in or out of the goal. 50m x 30m field. Duration: 10 minutes (T4).
Oriented possession (8 vs. 8). A goal is scored by crossing the goal line, in or out of the goal. 50m x 30m field. Duration: 10 minutes (T4).	Normal possession (8 vs. 8). One point (goal) is scored every 8 passes. 50m x 30m field. Duration: 10 minutes (T3).

Note. T1 = Task 1; T2 = Task 2; T3 = Task 3; T4 = Task 4.

Prior to starting every session, all players put the GPS on. After completing every task, VAS, NASA-TLX and RPE questionnaires were filled in. Once the training was finished, after stretching, the players took the GPS off. All tasks were recorded using a video camera (Sony HDR-PJ30VE). Furthermore, the technical staff's behaviour was similar during all tasks, i.e. they did not provide any specific feedback during any task or to any player.

Data analysis

The statistical package SPSS 25.0 (IBM SPSS Statistics for Windows, version 25.0. Armonk, NY: IBM Corp.) was used for data treatment and analysis. Firstly, Shapiro Wilk's test was applied to determine data normality. According to the results obtained, mental load and physical load were separated. Physical load was, in turn, divided into internal and external load. Subsequently, a descriptive analysis of every variable was conducted and the means were compared. Then, the data were grouped by tasks for analysis, so that Task 1 (T1) of both sessions were analysed together, and the same with the rest. Finally, a repeated-measures T-test was conducted to compare the results obtained in each session.

RESULTS

Analysis of the differences regarding internal load

Table 2 contains the mean and standard deviation of the internal physical load in the different tasks and the significant differences among them. It shows how RPE was lower in all oriented tasks, with significant differences between the 4 vs. 4 tasks. The values of HRM and HRMax were always higher in the tasks without orientation, yielding significant differences.

Table 2. Mean of internal load variables divided by task.

Tasks / Variables	T1 (Normal)		T2 (Oriented)			T3 (Normal)		T4 (Oriented)		
	M	*SD*	*M*	*SD*	*p*	*M*	*SD*	*M*	*SD*	*p*
HRM	167.94	9.91	163.05	9.25	***	170.94	8.69	166.72	9.36	.123
HRMax	179.61	8.73	177.27	8.97	***	182.88	8.31	179.72	8.69	*
RPE	8.33	1.14	7.77	.71	*	8.69	.82	8.02	.83	.065

Note. T = Task; Normal = standard possession; Oriented = oriented possession.
*** = $p < .001$; ** = $p < .01$. * = $p < .05$.

Analysis of the differences regarding external load

Table 3 contains the results of the external load variables distributed identically to the previous table. It can be noted that the total distance was always greater in the tasks without orientation, with significant differences in 8 vs. 8 tasks. Distance/min behaved similarly, reaching higher values in standard tasks. SMax was higher in the tasks with orientation, with significant differences between tasks. By contrast, SM yielded higher values in the non-oriented tasks. The number of sprints was always higher in the oriented tasks, showing significant differences ($p < .05$).

Table 3. Mean of external load variables divided by task.

Tasks / Variables	T1 (Normal)		T2 (Oriented)			T3 (Normal)		T4 (Oriented)		
	M	*SD*	*M*	*SD*	*p*	*M*	*SD*	*M*	*SD*	*p*
Total distance	415.33	25.55	406.61	24.44	.291	918.55	59.46	876.33	51.48	*
Distance/min	80.83	5.01	78.88	4.76	.238	92.00	5.88	85.27	4.13	***
SMax	15.19	1.28	16.62	1.65	**	19.08	1.34	21.10	1.39	**
SM	5.26	.28	5.12	.27	.155	5.85	.36	5.39	.25	***
Sprints	.22	.50	.94	.80	**	1.33	.96	1.55	1.04	.498

Note. T = Task; Normal = standard possession; Oriented = oriented possession.
*** = $p < .001$; ** = $p < .01$. * = $p < .05$.

Analysis of the differences regarding mental load

Finally, Table 4 shows the mean of the mental load variables in the different tasks. Despite not having found significant differences in this type of variables, it is true that the variables mental demand, physical demand, temporal pressure, effort, frustration and interaction of 4 vs. 4 tasks reached higher values when the task was not oriented, with significant differences in the variable interaction. By contrast, the variable motivation yielded higher values when the task was oriented. In 8 vs. 8 tasks, significant differences were found in the variables mental demand and physical demand. Furthermore, mental fatigue was higher when the task was not oriented. By contrast, the variables frustration and interaction showed higher values when the task involved orientation.

Table 4. Mean of mental load variables divided by task.

Tasks / Variables	T1 (Normal)		T2 (Oriented)			T3 (Normal)		T4 (Oriented)		
	M	*SD*	*M*	*SD*	*p*	*M*	*SD*	*M*	*SD*	*p*
Mental	71.11	16.35	67.77	10.34	.262	78.05	12.10	72.50	14.79	*
Physical	81.11	15.36	75.55	9.16	.128	85.00	7.18	79.16	7.50	*
Temporal	76.38	12.06	73.88	7.81	.347	76.38	8.39	74.44	10.73	.244
Satisfaction	67.22	6.05	69.16	6.84	.367	73.05	7.04	71.94	14.01	.786
Effort	75.00	13.97	72.77	9.63	.396	81.66	8.75	76.38	10.39	.139
Frustration	53.61	22.74	43.61	16.35	.081	50.00	14.79	58.05	26.97	.350
Interaction	71.11	17.77	65.27	16.69	**	68.88	12.44	69.16	12.37	.799
Fatigue	61.94	16.76	60.00	18.37	.402	69.44	14.88	63.61	15.16	.083
Motivation	64.16	21.13	67.50	16.00	.262	64.16	19.36	62.50	17.04	.804

Note. T = Task; Normal = standard possession; Oriented = oriented possession.
*** = $p < .001$; ** = $p < .01$. * = $p < .05$.

DISCUSSION

The aim of the present study was to analyse whether the modification of training task aspects, in particular spatial orientation, had consequences on the different parameters that identify work load, especially mental load, in women's football. The main results revealed that modification of the task orientation could be considered as a relevant variable in the training process, since it provides different stimuli to players and it affects players' RPE after a task, as it was confirmed by the results and in line with other authors (Casamichana et al., 2012).

Regarding physical load variables, lower values of RPE, TD and SM were obtained when orientation was added to the task. In particular, in both 4 vs. 4 and 8 vs. 8 tasks, physical load was lower in the tasks with spatial orientation, confirming the findings of previous studies where it was stated that adding spatial references decreased the physical demand of a certain task (Coutinho et al., 2017). Moreover, these results are similar to those from a study where spatial references were added to the task. Lower values of SM and TD were reached by players in the presence of such modifications (Coutinho et al., 2018).

An explanation for these results could be the team's self-organisation established when a task is modified, since having an attacking orientation allows players to have their aim clear and to know where to run towards, while having no defined orientation makes players run more and cover longer total distances, besides doing it using more irregular movement patterns. In relation to this, Gonçalves et al. (2017) proved that adding restricted areas to a task led to reduced physical demands regarding speed and distance covered, as well as greater player movement organisation. Nevertheless, when no restrictions were set, movement variability and speed increased. This movement irregularity and task complexity when no modifications are introduced may impose higher mental load, as it has been shown by our results, so that greater entropy means higher mental load (Cárdenas, Conde-González, & Perales, 2015). Thus, the hypothesis established, which stated that tasks with no orientation would impose higher mental load, can be considered to be true in light of the results obtained.

On the other hand, mental load variables changed differently after adding orientation to the tasks. The fact that task mental load is higher when no orientation is established may be, partially, due to the explained above, i.e. when there is no spatial reference, there is greater entropy. Besides, it can also be due to what some authors explained that adding perceptual references to a task narrows the attentional focus (Lind, Welch, & Ekkekakis, 2009), thus making the task have one single aim: to take the ball to one side. By contrast, when there is no orientation, players do not know where to direct their attentional focus, as they have the whole pitch to defend or attack, and the task mental demand increases.

Additionally, it was proved that physical demand was lower when the task included orientation, with significant differences in 4 vs. 4 tasks. Our results are in keeping with other authors who stated that adding spatial modifications to a task led to decreased perceived exertion (Casamichana et al., 2012). In particular, in 4 vs. 4 tasks, we found that motivation was higher in the oriented tasks. This could be related to RPE, so that a motivating task could lead to lower perceived exertion, confirming the significant differences obtained. According to Barte et al. (2018), players with experimentally-induced motivation showed lower decrease in their physical performance and were also able to uphold it, what may be related to our results. Consequently, having a high level of motivation or tasks being more motivating to players makes their physical performance be less negatively affected. Moreover, related to this, it can be noted how different variables are related to each other, as motivation affects satisfaction and frustration. In particular, in 4 vs. 4 tasks, motivation was higher in the oriented tasks, this producing higher satisfaction and lower frustration to players. This could be due to the type of task performed, where players were more involved and, because it was motivating, they felt secure. By contrast, in 8 vs. 8 tasks, motivation was lower in the oriented tasks, leading to lower satisfaction and higher frustration. In this case, the results may be due to the same previous reason: the type of task, more real and similar to a match, would generate competition stress or insecurity. Lastly, motivation also affects the mental load and fatigue generated. In 4 vs. 4 tasks, higher motivation leads to decreased mental load and the corresponding fatigue, revealing a potential tool to manipulate load in this type of tasks. Temporal pressure was verified to be lower in the tasks without spatial orientation, what may have been caused by the task purpose. Thus, in tasks without orientation, players must keep the ball, what generates greater pressure on them; however, when they must take the ball to one of the goals, they are calmer because they are better able to identify the target.

Finally, it can be observed how the level of mental fatigue behaved similarly to the level of mental load, leading to a logical cause-effect relationship, since this type of fatigue was the consequence of that load. More specifically, the oriented tasks imposed lower mental load and, consequently, produced lower mental fatigue.

CONCLUSIONS, LIMITATIONS AND FUTURE PERSPECTIVES

In conclusion, according to the results of this study, we have confirmed that metal load and physical load behave differently, so they need to be considered independently when designing training tasks. Besides, it is necessary to treat mental load as an independent construct from physical load, which imposes a different type of fatigue on the player. After having conducted this research, it can be stated that the constraints used when designing training tasks, especially the modification of task orientation, can significantly affect training load. Lastly, the modifications made affect each type of load, physical and mental, in a different manner. Therefore, it is necessary to treat each of them independently for appropriate control and quantification of training load.

Considering the characteristics of the present study, where mental and physical load were compared after modifying task orientation, and the novelty of the topic, it is necessary to bear in mind that it presents a series of limitations that should be addressed in future research in order to achieve higher empirical robustness. One of the major limitations of the present study was the reduced number of participants. Therefore, it would be advisable to conduct it with more teams and in different contexts. Besides, few sessions were performed, so more sessions and different types of tasks need to be proposed. Finally, future studies could address new strategies to modify tasks in order to better handle load, specifically mental load, such as modifying the time available, the technical difficulty or the general difficulty. This would contribute to proper design of a training programme.

PRACTICAL APPLICATIONS

Educational contributions can be extracted from the results obtained in this research: (i) to show the importance of load control and quantification through the strategy proposed to football trainers and strength trainers, (ii) to describe the effects of task modification on mental and physical load in women's football, with the aim to handle it logically to adequately plan and control training load and, consequently, to optimise performance, and (iii) to determine how adding orientation to a task affects female football players.

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