Journal of Human Kinetics volume 79/2021, 277-288 DOI: 10.2478/hukin-2021-0079 277
Section IV – Behavioural Sciences in Sport

Coach Encouragement During Soccer Practices Can Influence Players' Mental and Physical Loads

by
Jesús Díaz-García[1], Juan José Pulido[1], José Carlos Ponce-Bordón[1], Carlos Cano-Prado[1], Miguel Ángel López-Gajardo[1], Tomás García-Calvo[1]

This study analyzed the influence of the coaches' encouragement on the mental and physical load in soccer practices. The participants were 36 semiprofessional Spanish soccer players (M_{age} = 22.40; SD = 2.25) belonging to two male teams and one female team. Following the same practices' design and order, two training sessions of each team were completed. In one session, coaches maintained a passive verbal attitude, whereas in the other session, coaches intervened with an active attitude through continuous general encouragement. The mental load and fatigue were measured using self-reported questionnaires (Likert scales), and internal and external physical loads were quantified using the rating of perceived exertion and the Global Position System. A t-test for related samples and magnitude based on an inference spreadsheet was performed. The results demonstrated that mental and internal physical loads increased when coaches participated with active verbal encouragement. Especially, increases in performance satisfaction, mental effort, and RPE values, and decreases in unsafety values were detected due to encouragement interventions. Nevertheless, the external physical load did not show a clear trend. Based on these findings, coaches can use this information to manipulate their verbal encouragement during practices according to their physical and mental objectives with specific soccer strategies.

Key words: *coaching, constraints, soccer training, mental fatigue, training practice.*

Introduction

Recent research has indicated that mental and physical loads and fatigue in soccer training could be manipulated through the use of soccer-specific strategies (Thomson et al., 2020). When these strategies, such as technical and tactical limitations, are manipulated appropriately during practices, coaches could provide an intentional and specific training stimulus to competition demands (Casamichana et al., 2015). It has been proven that coaches' behavior could be intentionally manipulated and that it influences practice development (Dixon et al., 2017), thus soccer coaches' behavior acts as a specific soccer-training strategy. However, few scientific investigations have shown the consequences of modifying coaches' behavior on soccer training loads (Brandes and Elvers, 2017). The present study analyzed the influence of coaches' behavior during soccer practices on semiprofessional players' mental and physical training loads.

Soccer mental and physical loads and their manipulation through specific strategies

Training loads can be divided into the external (work prescribed by coaches) and internal load (players' psychophysiological responses) based on the markers used to record them (Impellizeri et al., 2019). In the soccer context, the load and fatigue have predominately been measured using neuromuscular and metabolic values (Thompson et al., 2020). Specific physical demands in soccer are caused by intermittent efforts like sprints, tackles, turns, headers, and dribbles (Dalen and Loras, 2019).

[1] - *Faculty of Sport Sciences, University of Extremadura (Caceres, Spain).*

Authors submitted their contribution to the article to the editorial board.
Accepted for printing in the Journal of Human Kinetics vol. 79/2021 in July 2021.

However, soccer also involves mental demands (Nedelec et al., 2012), and it has been shown that mental aspects impair soccer performance (Smith et al., 2016). The mental load of soccer practice can be defined as the mental effort necessary to solve the objectives of the practice in a certain time period, influenced by cognitive, emotional, affective, motivational and, also, physical demands (García-Calvo et al., 2019). This mental load can produce some level of mental fatigue, defined as the excessive stimulation of the nervous system caused by high levels of the mental load (Smith et al., 2019).

The organization and application of soccer training loads by coaches is a relevant aspect to improve performance and avoid mental and physical fatigue (Nedelec et al., 2012). There are different types of practices that coaches can use. Specifically, the use of the ecological dynamics framework is quite extended. Ecological dynamics assume that sport behaviors are based on the mutuality between performers and the environment, and the application of this theoretical framework in soccer implies that soccer practices should replicate competition efforts and characteristics in a specific context, in which coaches can manipulate concrete strategies to promote variety and autonomy in the performers' responses (Pol et al., 2020). Therefore, it is necessary to determine the influence of these specific soccer strategies on the load and fatigue so that coaches can optimize the use of these strategies according to their training objectives (Casamichana et al., 2015).

Several studies have described the influence of these strategies on soccer physical loads and fatigue. For example, Giménez et al. (2018) obtained lower intensity in efforts and higher percentages of walking time in a practice with an unlimited number of ball touches compared to another where only one touch per player was allowed. Olthof et al. (2017) reported higher physical distances with the use of larger pitch sizes in Small Sided Games. However, the influence of specific soccer strategies on mental loads has been understudied (Thompson et al., 2020). To our knowledge, only two papers have considered this topic. García-Calvo et al. (2019) found smaller values of the mental load reported by semi-professional players in practices with the traditional soccer scoring system (one goal = one point) than in practices where scoring a goal at the beginning (one goal = two points) or at the end (one goal = three points) multiplied the value of the goal obtained. Ponce-Bordon et al. (2020) observed higher values of the mental load in female players in possession practices (goals were obtained by certain numbers of consecutive passes) than in practices with traditional goals with goalkeepers. These studies manipulated the mental load through the ecological dynamics framework, using specific soccer strategies.

One soccer strategy that could facilitate the athlete-environment interactions in the ecological dynamics framework is the coach behaviour (Woods et al., 2020). Falcés-Prieto et al. (2015) indicated that the influence of coaches' behavior on the load has been understudied. Coaches' behavior is defined, among other aspects, by their methodological, communicative, or integrative strategies (Pulido et al., 2020). Concerning communicative strategies, Smith et al. (1977) classified coaches' verbal behavior as reactive (player action – verbal reaction) and spontaneous behavior (not associated with a player's concrete action). Spontaneous behavior includes: (1) general technical instructions (GTIs) or technical corrections (e.g., corrections of technical executions); (2) general positive encouragement (GE), which includes advice, but not corrections (e.g., come on!, good job!); and (3) organizational aspects (e.g., players' distribution or practice rules). A recent instrument to assess coaches' behavior is the Coach Analysis and Intervention System (CAIS), which includes information about coaches' verbal behavior (Cushion et al., 2012). This instrument includes praise (e.g., "your work rate was excellent today" and other supportive verbal or non-verbal behaviors that express the coach's general satisfaction, but which do not specifically aim to improve the player's performance), general positive feedback (e.g., "good try", "well done"), or hustling (e.g., verbal statements intended to intensify the efforts of the athletes), among other dimensions. The content of different coaches' behavior could affect the players' load responses (Brandes and Elvers, 2017). For example, GTIs include public or individual (positive or negative) technical comments, whereas GE or general positive feedback uses supportive statements. Players' reception and assimilation of feedback also depends on the social and individual climate (Cook and Crewther, 2014; Mason et al., 2020a). Therefore, knowing the effects of each type of the coach's behavior could optimize the use of these specific strategies by coaches.

Based on the classification proposed by Smith et al. (1977), Rampinini et al. (2007) found an increase in the heart rate, lactate, and Rating of Perceived Exertion (RPE) levels in Small Sided Games with GE in amateur soccer players. Weakley et al. (2019) reported that the use of GTIs allowed maintaining the same intensity level for a longer time in anaerobic exercises. Other authors (Brandes and Elvers, 2017) reported a decrease in the physical load levels with the use of GTIs during Small Sided Games, even if the RPE was increased. Thus, there is a lack of agreement about the consequences of these strategies on the physical load, and no examples were identified of studies that explained the effects of coaches' behavior on the mental load, although, the levels of motivation or pressure (Teques et al., 2019) and changes in players' satisfaction or social climate have been demonstrated (García-Calvo et al., 2014). Hicheur et al. (2020) compared non-feedback with augmented feedback training, finding that soccer players perceived their coach as an evaluator, enhancing their stress and concentration levels, which could increase the mental load. This would also explain the increase in the load of the practices as a function of the presence of the coach (Falcés-Prieto et al., 2015).

Previous studies have shown that different coaches' behavior could differentially influence training loads, indicating the need to separately investigate each verbal strategy. Therefore, more research may be required to test the relation between coaches' behavior and mental loads in soccer. Assuming the consequences of specific coaches' behavior on the load would contribute to designing more specific practices to train following objective and competition demands. Thus, the objective of the present study was to investigate the effects of coaches' GE on mental and physical loads and fatigue in real soccer practices. Accordingly, we hypothesized that GE would (a) increase the mental load and fatigue and (b) improve the internal and external physical load in soccer practices.

Methods

Participants

Thirty-six semi-professional soccer players composed the sample of the study (M_{age} = 22.40, *SD* = 2.25). Players were members of two male teams (M_{age} = 22.90; *SD* = 5.60) belonging to the Third Spanish Division (*n* = 11) and U-18 First Division (*n* = 11), and one female team (M_{age} = 21.90; *SD* = 6.20) of the First National Division (*n* = 14) during the 2018/19 season. This heterogeneous sample was used to detect possible different influences of this soccer strategy. Non-significant differences between groups were found in the results of the study. All teams performed four regular training sessions per week (90 to 100 minutes), with a break of two to three days after the last match and without days off between sessions. All participants had a minimum of 10 years of training experience.

Measurements

*Polar Team Pro System (Polar Electro, Finland, 2015)***.**

Polar Team Pro is a Global Position System (GPS) used to quantify the physical load of training sessions. This technology uses Polar sensors (Polar Electro, Finland) to monitor the load in real-time. Mean Heart Rate, Peak Heart Rate, Mean Speed, Distance/Minute, and Peak Speed were registered. The recommendations of Malone et al. (2017) were considered for GPS data collection.

Rating of Perceived Exertion.

To value the soccer players' perception of effort, the Rating of Perceived Exertion (RPE; Impellizzeri et al., 2004) scale was used. RPE values range from 0 (*not at all exhausted*) to 10 (*maximum exhaustion*).

NASA – Task Load Index.

To quantify the mental load, an adaptation of the NASA-Task Load Index (NASA-TLX) questionnaire was used (Díaz-García et al., 2021). Soccer players were asked about mental effort, physical effort, time pressure, performance satisfaction, general effort, unsafety, and interaction.

Visual Analog Scale.

The Visual Analogue Scale 100 (VAS100) is a quantifying procedure with values ranging from 0 (*minimum*) to 100 (*maximum*). This procedure was used to quantify the players' perceptions of mental fatigue during practices (Smith et al., 2017).

Inter-practice time (see study design and procedures) was used by players to complete the VAS-100, NASA-TXL, and RPE.

Study design and procedures

A meeting with coaches was carried out to explain the objectives and design of the study. The three clubs' managers accepted our intervention with their teams and signed a collaboration agreement. Players were informed about the objective of the study and signed informed consent before the start of the study, following the University Ethics Committee. All data were processed according to the ethics and privacy codes of the *American Psychological Association* (2010).

A quasi-experimental design was used. Two full normal training sessions with the same design and content were completed. A break between two and four days after the last match and also a day off between experimental sessions were granted to avoid residual effects of fatigue. The order of sessions was counterbalanced between teams to reduce learning effects. Thus, the female team performed the A-C before the P-C session, and the opposite order was used for the two male teams. A-C and P-C sessions used the same practices: practice one (P1), practice two (P2), practice three (P3), practice four (P4), and practice five (P5), described below in Table 1. The same warm-up was performed by the teams before starting these two sessions. The organization of the players, the width and length of the distances, and the inter-practice rest intervals were also the same. The inter-practice rest interval was two minutes between P1 - P2 and P2 - P3, and four minutes between P3 - P4 and P4 - P5.

This intervention was used as part of the players' normal training. Only the coaches' behavior was modified between sessions. On previous days, coaches were instructed by the researchers about how information could include or omit GE. In one session, coaches did not perform any verbal behavior (Passive Coach; P-C), and the researchers instructed coaches to remain quiet; they could not intervene, they only managed the players to change between practice. In another session, coaches could participate only through verbal encouragement (Active Coach; A-C).

In accordance with the clasification of Smith et al. (1977), coaches frequently expressed GE in this training session (4-6 GE per minute). This verbal encouragement was provided both to attackers and defenders. In both sessions, the coaches' attitude was controlled and filmed by the researchers to respect the research protocols. If coaches had implemented information that was not previously included in the GE, researchers should indicate this during the inter-practice time, but this did not occur during the study.

Statistical analysis

Data were analyzed with the statistical program SPSS 25.0 (2017) and Hopkins' (2017) specific pre-post crossover spreadsheet. Data were normally distributed according to the Shapiro-Wilk test, and means and standard deviations were calculated for all variables. Before the analysis, repeated-measures ANOVA yielded no significant group differences (two male teams and one female team). A paired t-test was performed for each variable and pair of practices (e.g., mental load in P1 of P-C session compared with the mental load in P1 of A-C session). Significant levels were set at 0.1%, 1%, and 5%. The magnitude of change, considered as effect size (ES), was also calculated (Cohen, 1988). Following Batterham and Hopkins (2006), ES was classified as: *trivial* (< 0.2), *small* (0.2 – 0.6), *moderate* (0.6 – 1.2), *large* (1.2 – 2.0), and *very large* (> 2.0). Magnitude-based inferences (MBI), with confidence intervals, were used to determine the possible benefit (beneficial or harmful effects) of the mental and physical load and fatigue between sessions. Following Cohen (Batterham and Hopkins, 2006), the smallest worthwhile change (SWC) to assess a change in variables between sessions was set at ES = 0.2. Moreover, a qualitative analysis of the changes using Batterham and Hopkins' (2006) classification was performed: 0.5 to 5%, *very unlikely*; 5 to 25%, *unlikely*; 25 to 75%, *possibly*; 75 to 95%, *likely*; 95 to 99.5%, *very likely*; and >99.5%, *most likely*.

Results

Mental Load and Fatigue

The results of the comparison between the practices of the P-C and A-C sessions for mental loads and fatigue are displayed in Table 2. In general, an increase in these variables in the A-C practice sessions was observed. General fatigue in P1, mental effort in P4, performance satisfaction in

P3 and P4, and physical effort, time pressure, and general effort in P4 and P5 showed significant differences between particular practice sessions. All of these significant values were higher in the A-C sessions. Especially, during possession practices, performance satisfaction decreased with P-C, whereas unsafety decreased, and general effort and fatigue increased in the same practices with A-C. The MBI analysis indicated that only changes in general fatigue for P1 and general effort for P4 were *very likely positive*. Most of the changes were classified as *likely* or *possibly positive*. The unsafety variable showed unclear differences in three of the five practices. Only performance satisfaction in P1 and unsafety in P5 were classified as *possibly negative.*

Internal Load

Table 3 shows the results of the comparison between the practices of the P-C and A-C sessions of the internal load based on heart rates and RPE values. The A-C session showed higher values than the P-C session in most of these variables. The mean heart rate in P2, P4, and P5, peak heart rate in P4 and P5, and RPE in P3 showed significant differences between the sessions. As with the mental variables shown in Table 2, all of these significant values were higher in the A-C sessions. According to the MBI, the peak heart rate in P5 changed to *very likely positive*. The rest of the changes were classified as *likely positive* or *possibly positive*, except for the RPE in P1 and the peak heart rate in P2, where the changes were *unclear*.

External Load

Finally, Table 4 shows the results of the comparison between the practices of the P-C and A-C sessions of the external physical load. P1 and P2 showed an increase in Distance/Minute and Mean Speed in the P-C session. In P5, Distance/Minute and Peak Speed showed significantly higher values in P-C compared to A-C. P3 and P4 showed a significant increase in A-C compared to the same practices in P-C. These changes agreed with the MBI values and were classified as *likely* or *possibly* in most cases. Only changes for distance/minute in P4 and mean speed in P2 and P4 were *unclear*.

Table 1

Design of the investigation. Practices description and order.

Practices	
Practice 1	Round Possession. 6 vs. 2. For attack players: two touches maximum per player. For defense players: when a defender intercepts the ball, the player who has been defending for the longest time changes to attack team. Field 10 x 7 m. Seven min long.
Practice 2	Round Possession. 6 vs. 2. For attack players: one touch maximum per player. For defense players: when a defender intercepts the ball, the player who has been defending for the longest time changes to attack team. Field 10 x 7 m. Seven min long.
Practice 3	6 + 2 vs. 6 + 2 Match. The + 2 jokers located in lateral areas. For 6 vs. 6 players: two touches maximum per player. For jokers; one touch maximum per player. Field 50 x 30 m. 10 min long.
Practice 4	6 + 2 vs. 6 + 2 Match. The + 2 jokers were located in lateral areas. For 6 vs. 6 players: no touch maximum limitation per player. For +2 players; two touches maximum per player. Field 50 x 30 m. 10 min long.
Practice 5	8 vs. 8 Match. No jokers and no touches maximum per player were used. Field 70 x 40 m. Eight min long.

Table 2

Mental load and mental fatigue results between A-C and P-C practices

		Practice 1		Practice 2		Practice 3		Practice 4		Practice 5	
Variables		P-C	A-C	P-C	A-C	P-C	A-C	P-C	A-C	P-C	A-C
ME	*M*	39.50	45.83	45.32	52.10	54.35	56.13	50.17	61.50	58.33	65.00
	SD	±23.06	±22.36	±23.27	±20.69	±28.66	±22.50	±30.75	±22.94	±22.35	±23.96
	t(*p*)	-1.09(.28)		-1.84(.07)		-.34(.73)		-2.28(*)		-1.88(.07)	
	ES	0.25		0.31		-0.01		0.24		0.27	
	%QI	63/37/0 Possibly +ive		73/26/0 Possibly +ive		16764/20 Unclear		59/40/1 Possibly +ive		63/35/2 Possibly +ive	
PE	*M*	38.83	43.50	47.58	51.45	52.90	62.09	53.83	69.50	64.30	72.88
	SD	±19.37	±22.29	±23.65	±22.44	±27.50	±25.26	±30.79	±23.21	±22.57	±24.78
	t(*p*)	-1.18(.25)		-96(.35)		-1.92(.06)		-2.85(**)		-2.31(*)	
	ES	0.14		0.18		0.23		0.24		0.48	
	%QI	40/55/6 Unclear		45/54/1 Possibly +ive		54/40/5 Unclear		59/40/1 Possibly +ive		89/10/0 Likely +ive	
TP	*M*	39.67	46.17	44.84	53.55	53.87	55.00	50.00	62.50	54.24	66.21
	SD	±24.46	±23.62	±21.04	±22.37	±26.67	±23.66	±28.53	±24.94	±24.65	±25.57
	t(*p*)	-1.46(.15)		-1.94(.06)		-.26(.80)		-2.81(**)		-2.45(*)	
	ES	0.39		0.32		0.00		0.22		0.44	
	%	84/16/0		76/24/0		16/67/17		57/43/0		92/8/0	
	QI	Likely +ive		Likely +ive		Unclear		Possibly +ive		Likely +ive	
PS	*M*	48.67	53.50	54.68	58.23	56.61	65.32	54.17	71.50	65.15	75.15
	SD	±24.63	±23.08	±24.96	±23.04	±28.41	±25.91	±29.80	±21.70	±24.75	±26.38
	t(*p*)	-1.09(.28)		-1.04(.31)		-1.88(.07)		-3.50(**)		-2.91(**)	
	ES	0.25		0.16		0.34		0.57		0.45	
	%	63/37/0		39/61/0		79/20/0		98/2/0		88/12/0	
	QI	Possibly +ive		Possibly +ive		Likely +ive		Very Likely +ive		Likely +ive	

Note. $^{**}p < .01$, $^{*}p < .05$; *P-C = Passive Coach; A-C = Active Coach; ME = Mental Effort; PE = Physical Effort; TP = Temporal Pressure; PS= Performance Satisfaction; SD= Standard Deviation; ES = Effect Size; % = %+/trivial/- QI = Qualitative Inference.*

Table 2

(Continued)

		Practice 1		Practice 2		Practice 3		Practice 4		Practice 5	
Variables		P-C	A-C	P-C	A-C	P-C	A-C	P-C	A-C	P-C	A-C
	M	48.67	53.50	54.68	58.23	56.61	65.32	54.17	71.50	65.15	75.15
	SD	±24.63	±23.08	±24.96	±23.04	±28.41	±25.91	±29.80	±21.70	±24.75	±26.38
G	t(*p*)	-1.09(.28)		-1.04(.31)		-1.88(.07)		-3.50(**)		-2.91(**)	
E	ES	0.25		0.16		0.34		0.57		0.45	
	%QI	63/37/0 Possibly +ive		39/61/0 Possibly +ive		79/20/0 Likely +ive		98/2/0 Very Likely +ive		88/12/0 Likely +ive	
	M	22.90	26.83	29.35	30.00	36.45	29.67	38.83	33.07	40.00	36.91
	SD	±23.27	±23.21	±23.37	±23.35	±29.30	±25.95	±28.82	±25.17	±22.37	±23.87
U	t(*p*)	-.97(.34)		-.20(.84)		1.07(.29)		.99(.32)		.13(.89)	
n	ES	0.16		-0.01		-0.21		-0.07		-0.32	
	%QI	41/57/2 Possibly +ive		13/72/15 Unclear		6/42/52 Unclear		11/60/28 Unclear		2/28/70 Possibly -ive	
	M	45.67	48.17	48.06	53.39	51.45	56.94	52.50	59.00	61.21	62.42
	SD	±26.19	±24.30	±27.32	±23.82	±28.44	±24.52	±29.15	±24.37	±26.58	±24.73
	t(*p*)	.82(.41)		-1.62(.12)		-1.11(.27)		-1.27(.21)		-.52(.60)	
I n	ES	0.10		0.18		0.08		0.17		0.05	
	%	19/81/0		43/57/0		28/62/10		43/54/2		25/61/14	
	QI	Likely Trivial		Possibly +ive		Unclear		Possibly +ive		Unclear	
	M	26.33	36.33	33.23	39.03	39.67	44.35	43.03	47.33	50.79	49.70
	SD	±19.25	±22.66	±22.49	±21.81	±23.06	±25.36	±28.80	±26.22	±23.48	±22.29
	t(*p*)	-2.18(*)		-1.31(.19)		-1.25(.22)		-.74(.46)		-.63(.53)	
F a	ES	0.55		0.25		0.14		0.12		0.10	
	%	95/5/0		60/38/2		37/60/4		34/60/6		27/69/4	
	QI	Very Likely +ive		Possibly +ive		Possibly +ive		Unclear		Possibly +ive	

Note. $^{**}p < .01$, $^{*}p < .05$; *P-C = Passive Coach; A-C = Active Coach; GE = General Effort; Un = Unsafety; In = Interaction; Fa= Fatigue; SD= Standard Deviation; ES = Effect Size; % = %+/trivial/- QI = Qualitative Inference.*

Table 3

Internal load results between A-C and P-C practices

		Practice 1		Practice 2		Practice 3		Practice 4		Practice 5	
Variables		P-C	A-C	P-C	A-C	P-C	A-C	P-C	A-C	P-C	A-C
MHR	*M*	133.77	137.00	132.32	138.67	147.10	154.58	146.80	155.10	157.04	162.13
	SD	±19.56	±17.46	±17.10	±16.14	±21.19	±16.44	±19.01	±16.14	±10.68	±9.51
	t(*p*)	-1.42 (.17)		-2.81(**)		-1.57(.13)		-2.14 (*)		-2.91(**)	
	ES	0.21		0.34		0.27		0.28		0.37	
	%QI	53/47/0 Possibly +ive		88/12/0 Likely +ive		65/34/1 Possibly +ive		69/31/0 Possibly +ive		90/10/0 Likely +ive	
PHR	*M*	158.70	162.60	160.61	163.00	171.42	178.42	170.43	178.87	175.79	181.54
	SD	±14.58	±17.32	±16.15	±15.62	±17.98	±13.56	±18.63	±12.57	±9.31	±8.39
	t(*p*)	-1.49(.15)		-1.05(.30)		-1.96(.06)		-2.42(*)		-3.45(**)	
	ES	0.23		0.00		0.35		0.35		0.50	
	%QI	58/42/0 Possibly +ive		6/86/7 Unclear		82/18/0 Likely +ive		84/16/0 Likely +ive		99/1/0 Very Likely +ive	
RPE	*M*	4.03	4.43	4.84	5.06	5.48	6.38	5.83	7.00	6.66	7.67
	SD	±2.18	±1.87	±2.13	±1.73	±2.64	±2.28	±3.13	±2.15	±3.96	±1.34
	t(*p*)	.87(.39)		-.58(.56)		-2.05(*)		-1.91(.06)		-1.33(.19)	
	ES	0.09		0.18		0.31		0.32		0.31	
	%	30/63/7		44/56/1		75/25/0		81/19/0		70/29/1	
	QI	Unclear		Possibly +ive		Likely +ive		Likely +ive		Possibly +ive	

*Note. ** $p < .01$, * $p < .05$; P-C = Passive Coach; A-C = Active Coach; MHR = Mean Heart Rate; PHR = Peak Heart Rate; RPE = Ratio of Perceived Exertion; SD = Standard Deviation; ES = Effect Size; % = %+/trivial/- QI = Qualitative Inference.*

Table 4

External load results between A-C and P-C practices

		Practice 1		Practice 2		Practice 3		Practice 4		Practice 5	
Variables		P-C	A-C	P-C	A-C	P-C	A-C	P-C	A-C	P-C	A-C
D/Min	*M*	43.13	38.07	38.01	37.32	86.26	91.42	81.57	87.90	104.00	98.88
	SD	±10.23	±8.22	±8.84	±6.74	±29.61	±23.32	±27.81	±25.58	±24.56	±21.36
	t(*p*)	2.82(**)		.47(.64)		-.82(.42)		-.99(.33)		3.11(*)	
	ES	-0.45		-0.13		0.18		0.13		-0.28	
	%	0/7/93		4/62/35		45/53/2		36/57/6		0/20/80	
	QI	Likely -ive		Possibly –ive		Possibly +ive		Unclear		Likely -ive	
PS	*M*	15.38	14.83	14.99	14.73	20.36	22.82	20.89	22.89	22.63	23.02
	SD	±3.54	±1.95	±2.72	±2.59	±4.41	±3.50	±3.43	±3.01	±3.25	±3.78
	t(*p*)	.81(.42)		.52(.61)		-2.51(*)		-2.62(*)		-.78(.44)	
	ES	-0.15		-0.13		0.45		0.41		0.05	
	%	2/60/38		3/63/35		91/9/0		88/12/0		16/80/5	
	QI	Likely -ive		Possibly -ive		Likely +ive		Likely +ive		Likely trivial	
MS	*M*	2.90	2.61	2.58	2.55	5.39	5.72	5.11	5.52	6.50	6.18
	SD	±.67	±.53	±.58	±.46	±1.81	±1.41	±1.73	±1.56	±2.03	±1.84
	t(*p*)	2.49(*)		.28(.75)		-.85(.40)		-1.03(.31)		3.26(*)	
	ES	-0.36		-0.08		0.18		0.13		-0.30	
	%	0/16/84		6/70/24		45/53/2		38/56/6		0/17/83	
	QI	Likely -ive		Unclear		Possibly +ive		Unclear		Likely -ive	

*Note. ** $p < .01$, * $p < .05$; P-C = Passive Coach; A-C = Active Coach; D/Min = Distance/Minute; PS = Peak Speed; MS = Mean Speed; SD = Standard Deviation; ES = Effect Size; % = %+/trivial/- QI = Qualitative Inference.*

However, differences were only found between the first-league referees (31.09±3.3) and the international referees (36.6±4.21, t= -1.94; p=0.029). As expected, the variance analysis applied to referees' experience displayed differences too (F=6,21; t= -2.62; p=0.006), but only between the first-league referees (11.45±2.94) and the international referees (17±3.43, t= -2.18; p=0.017).

In the next step, correlations between the anthropometric parameters, experience and the perception test results were estimated. Weak, positive, and significant correlations were only found between age and the Precision Index (r=0.34, p=0.019), and between age and the 'number of errors' (r=0.31, p=0.033).

Discussion

The results provided by this study clearly show that referees' executive attention vary depending on their function and the level of professional attainment, and that the quality of perception may influence the number and precision of decisions. They also demonstrate that referees' experience and age may strongly determine their executive attention. This knowledge may be instrumental in screening referees and developing criteria for recruiting future referees. The aim of the study was to test and compare the executive attention of the top soccer referees and assistant referees and to find out whether relationships between the selected indicators can explain their values. The study's results confirmed earlier conjectures that assistant referees have much better executive attention (PI = 94.13±3.85) than referees (PI = 89.62±4.36, p<0.01). This difference may be explained in terms of function-specific requirements. The study subjects were only different in the range of the tasks they were expected to fulfil (referee / assistant). Assistant referees frequently have to monitor many elements of the game to be able to assess the situation, such as foul play, the offside line, or kick-offs. This process requires full concentration and divisible attention (Catteeuw et al., 2010b). Moreover, unlike the lead referees, they cannot choose the optimal position for watching the situation, even though their position during the game determines whether the situation will be correctly assessed and, if inappropriate, may contribute to errors (Oudejans et al., 2000). In choosing their position assistant referees must comply with the rules and react to the situation on the pitch (the offside line). Interestingly, in this study referees performed only slightly faster (G718.6±97.9 - A686.7±86.3), but also made on average almost twice as many mistakes (G18.44±8.99 - A9.47±5.77 p<0.01). This means that assistant referees select stimuli definitely more efficiently, which may directly explain why they make fewer errors.

The variety of textbooks dealing with cognitive psychology proves that cognitive processes can be listed, classified and described from many angles, but this study concentrated on perception as a fundamental cognitive process. Given the complexity and variability of referees' tasks, it is quite obvious that their actions demand full concentration (Catteeuw et al., 2010a). Referees have to respond to many perceptual and cognitive requirements (Helsen and Bultynck, 2004). Full concentration is particularly important in situations involving short-lasting, but very intensive physical and perceptual effort, such as following the counterattack that ends up with a foul in the penalty area or observing the offside line by assistant referees in dynamic situations. Even a temporary distraction of attention may result in misjudgement likely to distort the result of the game. Errors can be prevented by maintaining maximum mental concentration, i.e. by focusing all attention on the situation. The demands imposed on assistant referees are particularly high. There are many valuable studies on the special character of their tasks and the requirements they have to cope with (Catteeuw et al., 2009; Gilis et al., 2008; Mallo et al., 2008). The issue of assistant referees' perceptual abilities has become so important that special training methods have been developed to improve them (Catteeuw et al., 2010a; Helsen et al., 2006).

Regarding the Precision Index, the first-league referees turned out to be definitely inferior to the Extraclass referees (t= -3.45; p=0.0008). They were also statistically less efficient than the international referees (t= -2.53; p=0.01). The Extraclass referees and the international referees were not statistically different from each other. The same pattern was found for the number of errors made in the test. The first-league referees were, again, less efficient than the Extraclass referees (t = -3.07; p = 0.002) and the international referees (t = -2.13; p = 0.023), but the Extraclass referees and the international referees were not different. Interestingly, the Extraclass-league referees ranked the highest for both the variables, whereas international referees were only second. The amount of information available at this stage of research was not sufficient to provide a reliable explanation to this ranking.

When referees were analysed alone, the number of statistically significant differences was definitely lower. It is interesting, though, that the Extraclass referees had the best results for the Precision Index again, but the first-league referees and the international referees were not different any more. That age-related (t= -2.98; p=0.002) and experience-related (t= -2.69; p=0.005) differences were found between the first-league referees and the international referees and that the first-league referees, the Extraclass referees and the international referees were also different for the Precision Index clearly shows that training and experience have a great impact on the development and improvement of some perceptual skills. In other words, long-term training may considerably correct perceptual deficiencies which affect referees in the first period of their careers, thus improving their performance. This means that age may positively contribute to the quality and adequacy of referees' decisions. Similar conclusions have been drawn by researchers focusing on the impact of age on the physical preparation of English Premier League referees (Weston et al., 2010). It was demonstrated that although older referees run shorter distances during the game, they make their decisions as close to the ball and the site of the foul as their younger colleagues who run more, thus showing better skills of optimizing physical activity, which they probably acquire with experience. The impact of age on referees' performance has also been the subject of other studies (Weston et al., 2006). Because the situation on the pitch is very changeable and the predictability of what will happen next is very low, referees must possess involuntary cognitive readiness and special abilities regarding concentration and divisibility of attention. Kosslyn et al. (1990) noticed that simple visual perception functions were accompanied by complex visual spatial perception processes. According to this concept, the absorption of visual information involves not only the pure perception of external changes (visual stimuli), but also activates the accumulated knowledge about their nature. Visual perception is constantly and dynamically enhanced by imagination and memory, anticipation of next events and abstraction, concentration of attention, as well as temporal cognitive processes (Kosslyn et al., 1990). The officiating of a game induces complex visual spatial perception processes in referees, who in extreme cases have to receive and process large amounts of information coming from different sources. Referees are expected to know which spot in the penalty area the crossed ball will hit, where frequently more than a dozen of players are struggling to take possession of it. Each physical contact may make the referee stop the game and penalize an individual player or the team. The referee must also be able to predict where the ball travelling with the given velocity and in the given direction, which he suddenly lost eye contact with, will reappear. The referee is also expected to know how the players of both teams may behave depending on their position on the pitch (Helsen et al., 2006). Important for these cognitive processes are the sense of passing time and the memory of temporal rhythms, but the ability to focus attention also plays an important role.

Conclusions

The results of this study support role specificity in association football refereeing. Referees and assistant referees have a common goal: application of the Laws of the Game in a uniform and consistent way. However, even closely related roles such as those of referees and assistant referees require specific skills and abilities. The research results have proved that referees' executive attention differs depending on their function and professional level, as well as indicated that the quality of the abilities may influence the number and correctness of decisions made during a game. Sport scientists and football governing bodies should acknowledge this when they produce development programmes for referees and assistant referees at different levels of professional attainment. This finding may be also instrumental in screening referees and developing criteria for recruiting future referees.

Acknowledgements

This work was supported by the Real Madrid-UEM Chair, in the 2017-2018 call. It was also supported by the Assistance to Research Groups (GR18102) of the Junta de Extremadura (Ministry of Employment and Infrastructure); with the contribution of the European Union through the European Regional Development Funds (ERDF). This research was also supported by an FPU predoctoral grant from the Government of Spain (Ministry of Education, Culture, and Sports) to Díaz, J. (FPU18/03660). This research also receive support from the Government of Spain (Ministry of Science and Innovation) for Pulido, J.J. (IJC2019-040788).

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Corresponding author:

Tomás García Calvo
Faculty of Sport Sciences. University of Extremadura
Avenida de la Universidad S/N. P.C.: 10003, Cáceres. Spain
Telephone: 0034-606890141
E-mail: tgarciac@unex.es