

## The Influence of Scoring Targets and Outer-Floaters on Attacking and Defending Team Dispersion, Shape and Creation of Space During Small-Sided Soccer Games

by

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*The effect of altered game formats on team performances during soccer practice can be harnessed by coaches to stimulate specific tactical behaviours. The aim of the present study was to analyse the influence of using (i) small goals [SG], (ii) goalkeepers [7G] and (iii) floaters [7GF] on the dispersion, shape and available space of teams during small-sided games (SSGs). Twenty-four male soccer players were distributed into four teams composed of five players, two goalkeepers and two floaters that performed six SSG bouts of 6 min, interspersed with 6 min of passive recovery. Offensive and defensive phases were also analysed separately in order to verify the preservation of basic principles of attacking (teams more stretched to create free space) and defending (teams more compact to tie-up space) during SSGs. The variables used to characterize the collective behaviour were: length [L], width [W], team shape [Sh], and team separateness [TS]. Results revealed that the teams showed different collective behaviours depending on SSG format and a playing phase: a) L and W were higher in attack than in defence in all SSGs; b) team shapes were more elongated in defence in all SSGs except SG; c) the space separating players from their closest opponents (TS) was shorter in 7G; and d) SG and 7GF elicited greater defensive openness due to increased team width. The results suggest that manipulating task constraints, such as goal size, presence or absence of goalkeepers and floaters can be harnessed by coaches to shape distinct team tactical behaviours in SSGs while preserving the basic principles of attacking and defending.*

**Key words:** task constraints, tactical behaviours, GPS device, team sports, coaching.

### Introduction

Recently, an ecological dynamics approach to team sports (Duarte et al., 2012) described emergent collective behaviours as being different from the sum of individual aggregated performances (Silva et al., 2013). A soccer game must be understood on the basis of reciprocal relationships between the state of movement of the attack vs. defence dimensions of both teams in interaction (Gréhaigne et al., 2011).

Thus, group (or team) behaviour emerges from interactions of three or more players looking

to cooperate and competing together to achieve common intended goals, communicating through synergetic relationships (see Riley et al., 2011, for a detailed explanation of the role of synergies during joint behaviour). In this sense, recent research has assessed tactical team behaviour using compound variables (Duarte et al., 2012), such as team dispersion measurements like length and width (Castellano and Álvarez-Pastor, 2013; Castellano et al., 2013), relative team position on-field, depicted by the centroids (Araújo et al.,

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2015), longitudinal and lateral inter-team distances (Frecken et al., 2012) with or without ball possession (Bartlett et al., 2012). Such measurements capture higher-order spatial-temporal relationships established between players which describe collective behaviours at different scales of analysis (intra- or inter-team level).

The distribution of players on the pitch during attacking and defending is a key-performance indicator when measuring spatial strategy (Castellano et al., 2013). It is known that attacking and defending imply different collective spatial organizations (Moura et al., 2013). Team dispersion can be assessed through measuring the teams' length and width whereas the ratio of length per width informs us about the shape of the team (Folgado et al., 2014), i.e., the preferable direction of player distribution (goal-to-goal or side-to-side directions). Supposedly, the team in attack will need to expand and create space to hamper the defending actions of opponents, while the defending team seeks to tie-up space and suppress spatial gaps which are crucial for attackers. In regular soccer matches, teams in attack tend to play wider in the central areas of the pitch while forming deeper shapes when they are close to the targets (Castellano et al., 2013). These are basic and fundamental principles of team coordination in association soccer (Ouellette, 2004). Nonetheless, to the best of our knowledge, the analysis of such playing principles during SSGs has rarely been addressed. From a pedagogical point of view, it is important to verify whether the modifications introduced into SSGs misrepresent such important principles during play. In the study of Folgado et al. (2014), it was found that younger participants tended to present spatial distributions preferably in the goal-to-goal direction and shorter centroid distances when compared to older participants. This was interpreted as a less consistent application of attacking and defending principles and emphasizes the need to differentiate attacking and defending organization in performance analysis during SSGs.

Small-sided games (SSGs) are widely used as part of soccer training (Halouani et al., 2014) enabling coaches to simultaneously address various objectives like the development of technical skills, conditioning and psychological

aspects (Hill-Haas et al., 2011). The effects of various SSGs formats on physical, physiological and technical determinants are well described in relevant literature (Casamichana and Castellano, 2010; Clemente et al., 2012; Hill-Haas et al., 2011). It is known that such collective variables change in accordance with the constraints that are imposed by the environment (e.g., playing home or away), the task (e.g., different field dimensions or game rules) and also participants' characteristics (e.g., a skill and opponent level) (Bartlett et al., 2012; Castellano et al., 2013; Frencken et al., 2013). In this sense, the comparison of team behaviours that emerge under a given set of constraints may provide information about the co-adaptation of players to the task and how specific constraints can be manipulated to shape specific tactical behaviours. However, the lack of scientific background about the effects of altered game conditions on tactical team behaviour (Gréhaigne and Godbout, 2013) during soccer practice limits our understanding about how and what tactical behaviours emerge during specific SSGs formats.

Research on team behaviours in soccer has recently been focusing on the type of tactical behaviours displayed by small groups of players (Frencken and Lemmink, 2008) during the practice of several distinct SSGs, namely the teams' dispersion, its shape and the available space to play. For instance, Frencken et al. (2013), assessing 4-a-side SSGs, showed how length and width manipulations in field dimensions during SSGs triggered changes in lateral and longitudinal inter-team distances. Larger fields elicited longer distances between teams, which means that more space can be created during SSGs played on larger pitches. Thus, by manipulating field dimensions, practitioners can create favourable or unfavourable conditions for attacking and defending (Silva et al., 2014a, 2014b; Vilar et al., 2014). Silva et al. (2014b), for instance, showed that players were further apart from their direct opponents when they played in fields of larger dimensions. The shape of the teams may also change according to the specific constraints acting on the players. Folgado et al. (2014) also showed that teams varied their shape during SSGs according to age and player numbers involved in the task by measuring their length per width ratio. Other corroborative examples of a

constraints-led approach applied to soccer SSGs can be found in studies that investigated manipulations of numerical relationships (Silva et al., 2014c; Travassos et al., 2014) as well as the type and number of scoring targets (Travassos et al., 2014). With respect to this latter study, manipulations of the number of scoring targets from 2 to 6 in soccer SSGs elicited an increase in the distance between the teams' centroids, promoting different spatial relationships between opposing players. More research is needed to know how different changes in the SSG formats affect the teams' spatial distribution, shape and space creation during attacking and defending, considering that, for example, there is no information about how the inclusion of outer-floaters could alter the basic principles of attacking and defending during soccer play.

In this context, to the best of our knowledge no study has yet examined how the same players co-adapt to the task constraints imposed on tactical coordination when manipulations of the scoring targets, outer-floaters and goalkeepers are undertaken, distinguishing the co-adaptive tendencies occurring during attacking and defending sub-phases. Thus, the aim of the present study was to determine whether changing the game format (SSG with small goals but no goalkeepers, SSG with regulation goals and goalkeepers, and SSG with goalkeepers and outer-floaters), while maintaining constant all other variables (relative pitch size per player, a number of players per team, duration, recovery time, balls placed around the touchline so as to maximize the real playing time, and rules used) would influence the response of teams behaviors. The applications of the results could be harnessed by coaches to shape distinct team tactical behaviours in SSGs while preserving the basic principles of attacking and defending.

## Material and Methods

### Participants

The participants were twenty-four undergraduate sports science students (age:  $19.1 \pm 1.2$  years; body height:  $176.2 \pm 8.7$  cm; body mass:  $71.9 \pm 6.5$  kg; experience in soccer practice:  $8.3 \pm 1.5$  years at a regional amateur level) distributed into four technically balanced teams composed of one goalkeeper plus five outfield players

(Casamichana and Castellano, 2010). In addition to the team players, two outer-floaters were used in one SSG format (these players only played as outer-floaters during all treatments and trials).

All the players were informed about the objectives of the research and its requirements, as well as the potential benefits and risks and signed an informed consent form authorizing their participation. All procedures followed the guidelines stated in the Declaration of Helsinki and were approved by the University of the Basque Country Ethics Committee.

### Measures

The participants performed in three different SSG formats (Figure 1): 1) SSGs using goalkeepers defending 7-a-side goals (7G); 2) SSGs without goalkeepers, using two small goals (SG) of 2.5 x 1 m (width x height) at either end of the goal line; and 3) SSGs with goalkeepers using 7-a-side goals and two floaters on the outer lateral sides of the field that played with the team in possession (7GF). The aim of the players was simply to score more goals than their rivals. All the games took place on the same artificial grass facilities, within the same field dimensions of 40 x 25 m (length x width). The SSGs were played in periods of 6 min, interspersed with 6 min of passive recovery. All the standard rules of 11-a-side soccer were followed with the exception of the **Offside** rule.

### Procedures

The session began with a 15 min standard warm-up followed by the SSGs of different formats and teams. The order of the SSGs was randomly set (Table 1). During rest periods, players were allowed to drink fluids *at libitum*. All participants were advised to maintain their normal diet, with special emphasis being placed on high intake of water and carbohydrates. In all SSGs eight balls were distributed around the edge of the pitch in order to maximize the effective playing time (Casamichana and Castellano, 2010).

The players' positioning was recorded using portable global positioning system (GPS) devices operating at a sampling frequency of 10 Hz (MinimaxX 4.0, Catapult Innovations). The pitch was calibrated with four GPS devices placed in each field corner before the trials. The technology used to collect this data had been previously validated and shown to be reliable for monitoring soccer players (Castellano et al., 2011).

The GPS had good satellite connectivity (the mean of connected satellites was  $9.3 \pm 0.4$  during games).

Furthermore, the SSGs were filmed using a video camera (25 frames per second, HD) placed approximately 20 m from the goal line at a height of 5 m. The SSG footage was used to register ball possession via subsequent manual notation, on a Microsoft Excel datasheet, using 0, 1 and 2 as "team A in possession", "team B in possession" and "play set off", respectively, second by second (each datasheet line corresponded to 1 s of play). This data was then crossed temporally with the collective variables time series to extract values during offensive and defensive phases and exclude all play set off. To assess intra-observer reliability, the data was compared across two observation sessions of the same small-sided games. The results showed almost perfect agreement,  $Kappa > .91$  (Cohen, 1988).

#### *Intra- and inter-team variables*

Collective intra-team behaviour was studied through the analysis of team dispersion measurements – length, width and team shape. Inter-team interaction was assessed through measurements of team separateness (description below).

The team width (W) was defined as the distance between the two players furthest apart on the side-to-side direction, and length (L) was defined as the distance between the two players furthest apart on the goal-to-goal direction (Frencken et al., 2011). To analyse team shape (Sh), the relationship between width and length was used (Folgado et al., 2014) and calculated as a ratio between length and width (for ratios above 1, the teams were considered to present elongated shapes whereas for ratios below 1, teams were considered to present flattened distributions).

Team separateness (TS) was defined as a measure of the degree of free movement each team had available. It was computed by organizing the distances between opposing players in a pair-wise distance matrix  $M(t)$  of order 25 ( $5 \times 5$  players, excluding goalkeepers). The TS for a team was defined as the sum of distances between each team player and the closest opponent. This measurement can be interpreted as the radius of action free of opponents. A TS measurement was used to determine the closeness of the team players (Silva

et al., 2014b). A value of TS close to 0 indicated that all players were closely marked, while larger values indicated more freedom of movement. All variables had units of meters (m) and were down-sampled to two measurements per second (2 Hz, hence each SSG yielded 720 data points), here considered sufficiently large time resolution to capture the time variation and behavioural dominance of all variables.

Team length, width and team shape were calculated for the offensive and defensive phases separately. All periods of game stoppages were excluded from the analysis of all variables (L, W, Sh and TS). L, W, Sh and TS were compared between treatments across SSGs. Furthermore, L, W and Sh were compared between ball possession and no possession phases within each SSG. All variables were computed using Matlab R2009a (The MathWorks Inc., Natick, MA, USA).

#### *Statistical analysis*

Data was analysed for practical significance using magnitude-based inferences (Hopkins et al., 2009). Between-treatment effect sizes with 90% confidence intervals were calculated using pooled standard deviations. Threshold values for Cohen's effect sizes (Cohen, 1988) were  $>0.2$  (small),  $>0.6$  (moderate), and  $>1.2$  (large). Probabilities were calculated to assess whether true effects obtained represented substantial changes (Batterham and Hopkins, 2005). The smallest standardized change for each variable was considered to be 0.2 multiplied by the between-subject standard deviation value, based on the Cohen's effect size principle. Quantitative probabilities of higher or lower differences were evaluated qualitatively as:  $< 1\%$ , almost certainly not; 1-5%, very unlikely; 5-25%, unlikely; 25-75%, possible; 75-95%, likely; 95-99%, very likely;  $>99\%$ , almost certain (Hopkins, 2002). If the probabilities of the effect being higher or lower than the smallest worthwhile difference were simultaneously  $>5\%$ , the effect was deemed unclear.

## **Results**

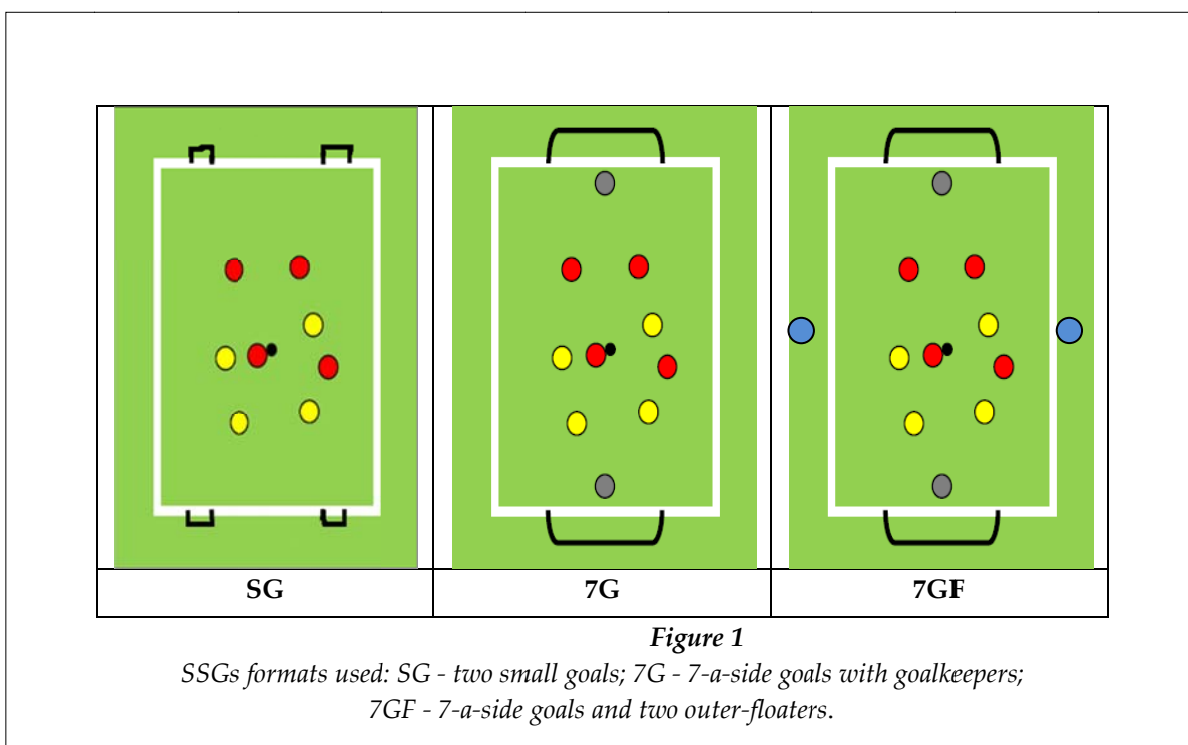
Table 2 shows mean  $\pm$  standard deviation of all variables: L, W, Sh and TS (team length, width, shape and separateness). For L and W, mean values were larger during the attacking phase, whereas for Sh, teams were more elongated during the defending phase in 7G and

7GF treatments. In the SG treatment, teams displayed an identical extension during attacking and defending. Figure 2 shows the magnitude of such differences (between attack and defence). For L, only in the SG and 7G treatments meaningful differences were found (small and moderate, respectively). For W, all differences were meaningful, varying from small in SG and 7GF to moderate in 7G. For team shape, differences were negligible in all treatments.

With regard to differences between treatments, it is worth noticing that during the

attacking phase, teams were slightly longer in 7G than in the remaining treatments (Figure 3). There were no differences between SG and 7GF during attacking. Differences in L during defending were also negligible.

Regarding W, a similar trend was found for the attacking phase, with teams playing slightly wider in 7G than in the remaining SSGs. No significant differences were found between SG and 7GF. Nonetheless, during defending in 7GF and SG treatments, teams displayed slightly larger values of W than in 7G.



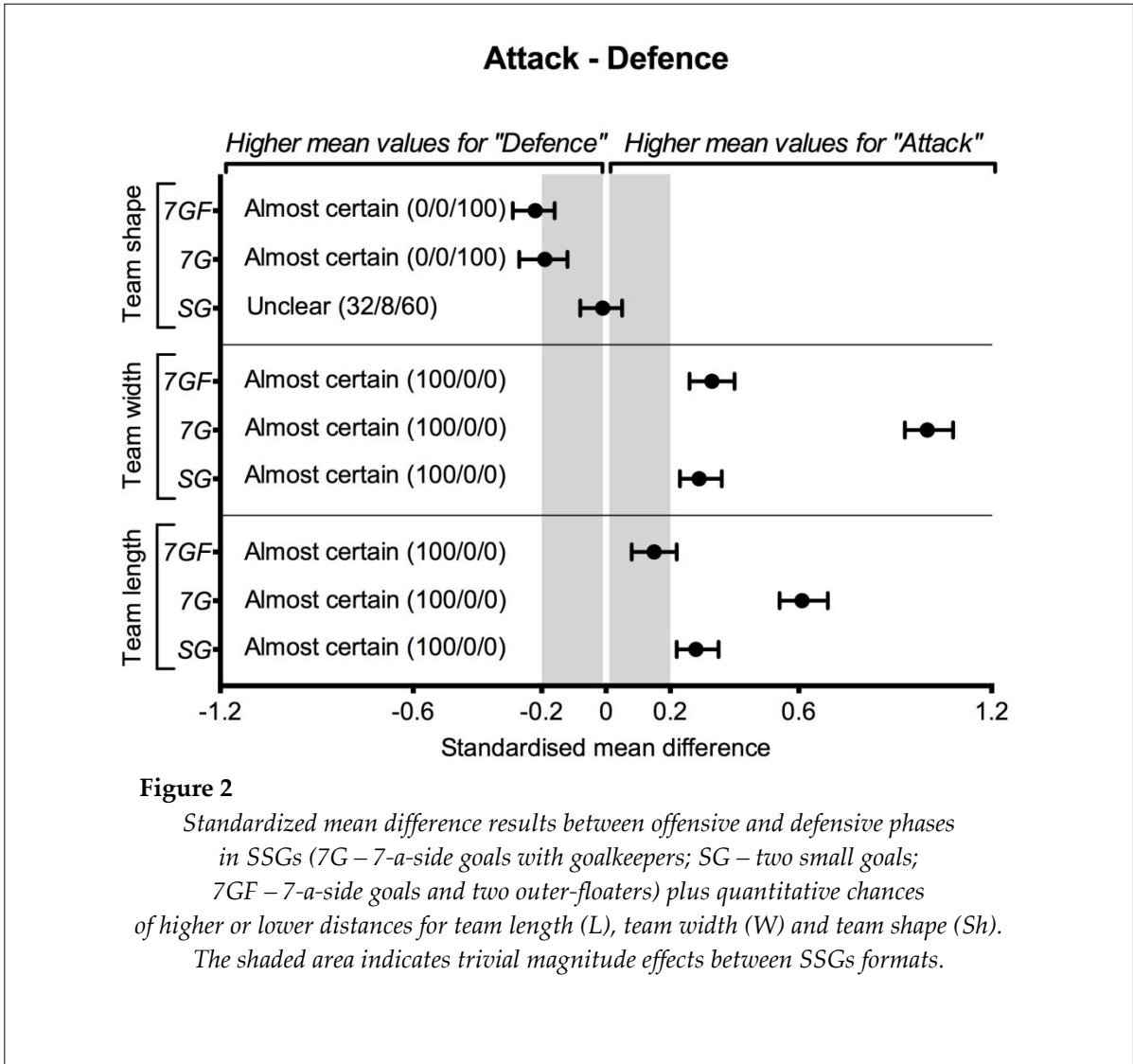
**Table 1**  
Order of games played, percentage of ball possession and mean time duration of each teams' offensive sequences (in seconds – s) in small-sided games

Teams	SSG format	% Total possession			Offensive sequences mean duration (s)	
		Team 1	Team 2	Play set off	Team 1	Team 2
A vs B	SG	57.5%	31.4%	11.1%	13.8±7.8	7.13±4.4
C vs D	SG	43.1%	38.3%	18.6%	14.1±4.9	13.8±5.9
A vs B	7G	31.7%	41.1%	27.2%	11.9±8.3	8.8±3.9
C vs D	7G	25.0%	43.1%	31.9%	10.0±9.0	9.1±6.8
A vs B	7GF	39.7%	41.7%	18.6%	13.0±10.5	13.5±7.4
C vs D	7GF	39.7%	41.1%	19.2%	11.9±10.6	12.5±6.8

A, B, C and D are teams and SSG format corresponds with: SSG<sub>MG</sub> - with mini goals, SSG<sub>7G</sub> - with 7-a-side goals and goalkeepers, and SSG<sub>7GF</sub> - 7-a-side goals and goalkeepers plus floaters

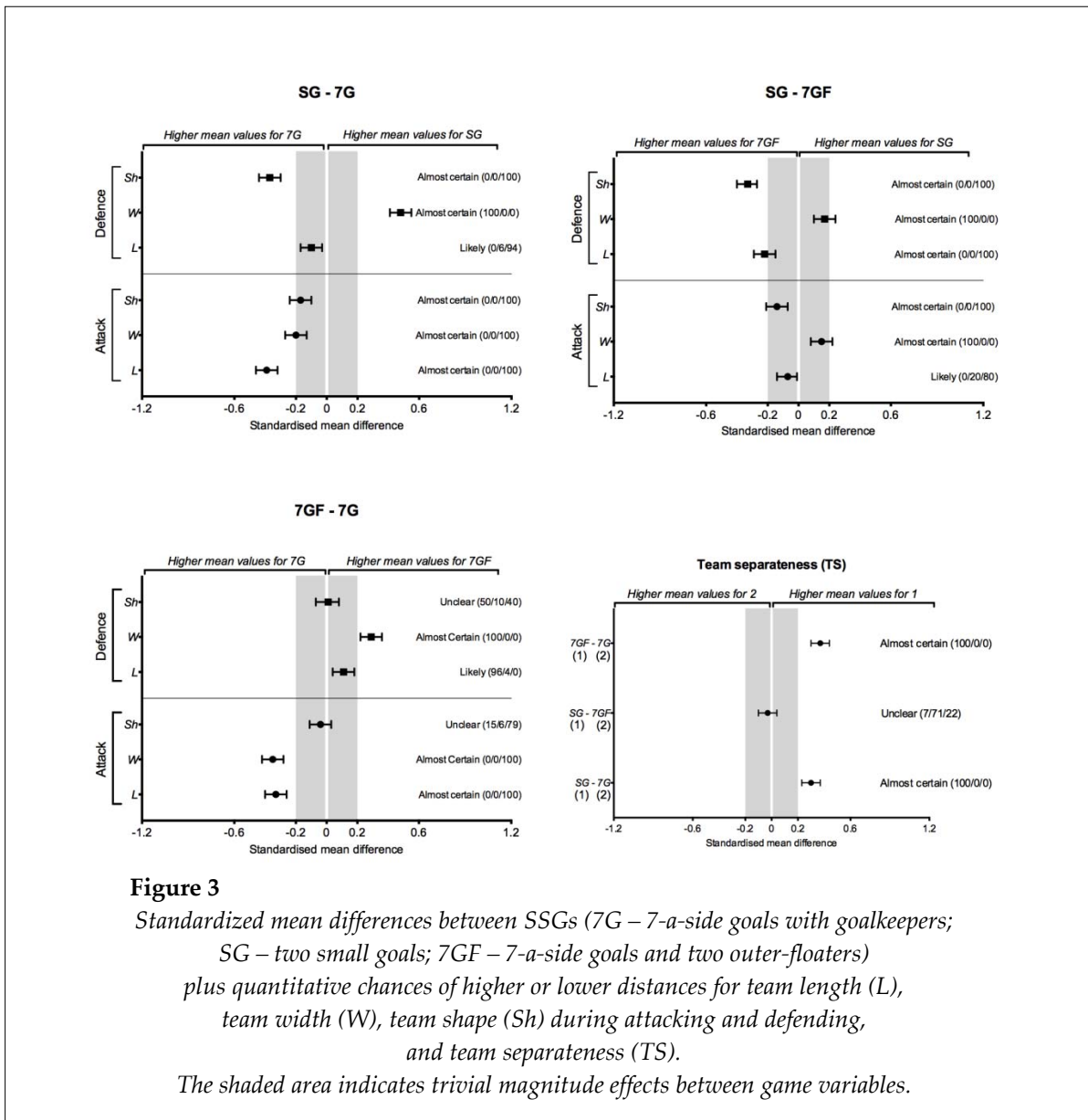
**Table 2**  
*Mean ± standard deviation of all variables according to small-sided game format.  
 N represents the number of data points used that were considered in each treatment  
 (after excluding game stoppages – i.e., 720 data points  
 per SSG \* 2 SSGs per treatment – data points corresponding to game stoppages).*

	Team length		Team width		Team shape		Team separateness
	Attack	Defence	Attack	Defence	Attack	Defence	
SG N=1225	14.11±5.05	12.8±4.14	15.02±3.71	13.71±4.50	1.02±0.54	1.03±0.51	25.16±7.46
7G N=1013	15.95±4.33	13.25±4.45	15.96±4.77	11.74±3.54	1.12±0.56	1.28±0.55	23.15±5.62
7GF N=1153	14.46±4.56	13.76±4.60	14.38±4.20	12.93±4.59	1.09±0.50	1.23±0.68	25.38±6.38



**Table 3**  
*Synthesis of intra- and inter-team behavioural trends across SSGs.*

SSG	Intra-team / attack			Intra-team / defence			Inter-team
	L	W	Sh	L	W	Sh	
From 7G to SG	Lower	Similar	Similar	Similar	Higher	Flattened	Higher
From 7G to 7GF	Lower	Lower	Similar	Similar	Higher	Similar	Higher
From SG to 7GF	Similar	Similar	Similar	Higher	Similar	Elongated	Similar



**Figure 3**

*Standardized mean differences between SSGs (7G – 7-a-side goals with goalkeepers; SG – two small goals; 7GF – 7-a-side goals and two outer-floaters) plus quantitative chances of higher or lower distances for team length (L), team width (W), team shape (Sh) during attacking and defending, and team separateness (TS). The shaded area indicates trivial magnitude effects between game variables.*

For Sh, meaningful differences between SG and the remaining treatments (7G and 7GF) were found only during the defending phase, with the first eliciting identical values of length and width, and thus, a less elongated shape. As far as TS is concerned, players and opponents were slightly closer in 7G than in 7GF and SG where values of TS were similar.

## **Discussion**

This study examined the tactical behaviours that occurred during SSGs manipulated through different task constraints during the attacking and defending phases. In general, results showed that teams co-adapted their collective behaviour differently in attack and defence and that they displayed distinct playing patterns when task constraints were manipulated.

The present findings are consistent with previous studies (Silva et al., 2014a, 2014b), which found distinct team co-adaptation patterns according to the constraints being manipulated in the SSGs. Modifying elements for a training design is important, since team sport players learn to adapt their behaviours in order to resolve game problems.

Previous researchers (Halouani et al., 2014; Köklü et al., 2015) have focused their attention on individual variables such as the presence/absence of goalkeepers or the inclusion of floaters (Castellano et al., 2013; Dellal et al., 2008; Mallo and Navarro, 2008). These studies showed differences in the physical and physiological profile of the players. However, the results are inconclusive and sometimes even contradictory, for reasons such as (i) the level of player motivation when attacking the goal, (ii) greater ease of defensive spatial organisation when the pitch has goals and goalkeepers, or (iii) the possibility that teams may lose the ball less when floaters are in play. This may affect the energetic demands of the players. Nevertheless, it is still not known to what extent collective behaviour is affected by the various modifications or rule changes proposed in SSGs that could help improve our understanding of the effects provoked in players and teams.

From a global perspective, it has been detected that in SG and 7GF formats, possession duration tended to be higher than in 7G, although the justification may be different for each SSG. On

the one hand, in 7GF, in line with the work of Mallo and Navarro (2008), the presence of outer floaters can result in a decrease in passing errors due to numerical superiority in the attacking phase. On the other hand, the motivation coming from the need to approach small goals (SG) as far as possible could be the reason for prolonged team possession, in a search of the best alternative. In contrast, the response of reduced possession duration in 7G formats could be due to the teams' 'greater' need to finish the offensive phase from a distance by a shot on the goal.

### *Intra-team' behaviour variables*

From the results obtained in this study, it is worth pointing out that changes in game format rules led to collective team adaptations, respecting a common tendency. In general, results showed that in all SSGs, teams were longer and wider while attacking and slightly more elongated than flat when defending. Thus, teams respected the defensive and offensive principles of play (Ouellette, 2004). There was an exception for the SSG played with small goals (SG), where width and length closely matched during attacking and defending. A probable justification for this could be the need for a wider team disposition in the defensive phase to defend the two mini goals at either end of the goal line.

Small-sided games that more closely replicated regular matches (i.e., 7G) elicited larger length values when attacking, but when defending they were similar in all treatments. The same trend occurred in team width during attacking, however, during defending teams were slightly wider in SG and 7GF than in 7G. In this last format, teams in the defensive phase had to accumulate players to defend one goal situated on the goal line on the central axis of the pitch. However, in the SSG with floaters (7GF), the teams were probably forced to defend the passing lanes with floaters playing on the wing, provoking an increase in the width of the team. These results contradict those obtained by previous studies (Silva et al., 2014c; Travassos et al., 2014), according to which in a situation of numerical disadvantage 5:4 or 5:3 (as is the case in point of 5 against 5 plus two outer floaters making it 7:5), the teams in a position of inferiority prioritised the occupation of space near their own goal and playing in a more compact way. However, unlike these studies where the floaters



played inside the pitch, in our study the floaters were outside the area of play (on the sides of the field). Therefore, maintaining a too compact position in defence may have not favoured the interception of balls crossed by the floaters. The same collective behaviour occurred in the SG format with mini goals on the four corners. In both formats (7GF and SG), coaches should evaluate whether the incorporation of floaters on the wings or placing of goals in the four corners could constrain the defence to act in a way which is not in accordance with the principle of defending (i.e., defending their goal in a more compact spatial organization).

As a result of the particular length and width adaptations performed by teams during the defending phase, the shapes were also more elongated when playing with 7-a-side goals (i.e., in 7G and 7GF) than when playing with small goals (SG) where five teammates spread out with the purpose of defending the goals.

#### *Team separateness*

With regard to the space separating players from their nearest opponents, it was again in the 7G which more resembled regular matches, where attackers and defenders were slightly more closed. In the study carried out by Silva et al. (2014b), where goals and goalkeepers were used, this variable increased along with pitch dimension. The study by Frencken et al. (2013) also verified the same tendencies by reporting increasing distances between the centroids. Manipulations of the pitch size incited adaptive interactive team behaviours in both longitudinal and lateral inter-team distances. In this study, team separateness did not vary between the SG and 7GF formats, but it was longer in the former than in 7G. Probably, the possibility to shoot from a greater distance in the 7G constrained the defenders to be closer to the attackers in this SSG format.

In summary, this study showed that teams naturally changed their spatial dispersion, shape and the distances maintained to direct opponents when scoring targets, goalkeepers and outer-floaters were manipulated in SSGs. The strategies adopted by teams revealed different co-adaptation patterns during attacking and defending phases where, basically, the key principles regarding the spread of players were preserved as a function of having the ball or not,

whatever the constraints that were acting upon the players. In this sense, such SSGs may be considered as representative of the basic principles of attacking and defending in soccer. The results of this study also identified meaningful collective behaviours that were promoted through manipulation of goals, outer-floaters and the presence of goalkeepers: 1) outer-floaters could be used to favour conditions for the attacking team to maintain ball possession; 2) the use of small goals could be harnessed to stretch teams during defending and promote the creation of spaces for the attacking team; and 3) the fact that different offensive and defensive playing styles may emerge according to the type of constraints manipulation (e.g., the type of goals and outer floaters) should be taken in account during earlier stages of player development (see Table 3 for a synthesis of main effects promoted with the use of SG, 7G and 7GF).

In this sense, coaches can use small goals distributed along the end line to promote more flattened defensive lines and distribution of players preferably in the side-to-side orientation during defending. Furthermore, it is suggested that constraining players positioning to the side-lines may favour creation of attacking plays, since an increased defensive width was registered and thus, greater defensive openness when such behaviours occurred. To do so, again the use of small goals near the side-lines may be an option, or playing with larger goals but using outer-floaters.

This knowledge can be used by practitioners to stimulate specific collective behavioural adaptations in players using small-sided games, independently of the small sample of SSGs studied and the depth of our analysis.

The findings of this study should be interpreted with caution, as interacting individual (skill, age, experience, physical fitness, etc.) and task constraints (like those studied in this work) may possibly elicit different co-adaptation of players. Additionally, as shown previously in studies comparing players with different skill levels, different tactical behaviours can emerge as a function of expertise (e.g., Silva et al., 2014c). It should be highlighted that our study encompassed only a sample of recreational players.

More research is warranted in order to

provide deeper understanding of the teams' behaviours during soccer games. Manipulating other constraints could give us information about emergent behaviour that can be used in a

pedagogical context to improve tactical performance.

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