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How perceiving additional targets modifies teams' tactical behavior during football small-sided games

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ABSTRACT

This study aimed to measure how the change on targets information modifies teams' tactical behavior during football small-sided games. 20 male senior professional players divided in 4 teams of 5 players participated in the study. Each team played two small-sided games, one with 2 official targets with goalkeeper and one with 6 small targets. Positional data of each player were recorded using a 15 Hz portable GPS. The distance between the centers of gravity (CG) of both team, the stretch index and the relative stretch index were measured and differences accessed via standardized differences, coefficient intervals and meta-analysis procedures. A moderate increase on the distance between the CG of each team and a small decrease on the stretch index and on the relative stretch index from 2 targets to the 6 targets games was observed. It was also identified that pitch location affected the interaction between teams. When the game was played in lateral corridors or defensive sectors, the differences between game conditions increased. Emphasizing the information for attacking team to shoot at goal, by manipulating the number of targets constrained tactical behavior of teams. The amplification of specific information on small-sided games can help coaches to promote players and teams' emergent adapted behaviors.

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1. Introduction

The use of small-sided games (SSGs) is very popular for association football training in young and adult professional players (Fenoglio, 2003; Katis & Kellis, 2009; Rampinini et al., 2007). Coaches are using SSGs on the assumption that it replicate the cinematic, physiological, technical and tactical demands of the game (Gabbett, Jenkins, & Abernethy, 2009; Hill-Haas, Dawson, Impellizzeri, & Coutts, 2011; Katis & Kellis, 2009).

One of the most important issues on SSGs is the design and the manipulation of the practice tasks according to the learning aims (Davids, Araújo, Correia, & Vilar, 2013; Tessitore, Meeusen, Piacentini, Demarie, & Capranica, 2006). In fact, the improvement of each physical, technical or tactical aim is dependent on task design and there is a need to better understand the effect of the manipulation of each constraint on players and teams behavior (Aguiar, Botelho, Lago, Maças, & Sampaio, 2012). Despite increasing the amount of research conducted into SSGs in Association Football, there is little information regarding to the effects of the manipulations of SSGs on tactical skills of players and teams (Hill-Haas et al., 2011). Over the last years, there were some attempts to improve the understanding of the tactical aspects of the football game and practice tasks by considering the interactions between opposing players and/or teams (see some examples in Travassos, Davids, Araujo, & Esteves, 2013). Based on ecological dynamics approaches (Araújo, Davids, & Hristovski, 2006), team sports can be viewed as super-organisms in which the ongoing spatial–temporal interactions between players is a consequence from the constant information exchanges between teammates and opponents, either from a local (player–player) and from a global (team–team) levels of organization (Duarte, Araújo, Correia, & Davids, 2012). Accordingly, the analysis of tactical behavior requires to account for the emergence/dissolution of coordination patterns, considering the dynamics of players' distribution on the pitch always in interaction with the ball kinematics and the scoring targets location (McGarry, 2009). For instance, the creation of local numerical superiority and spatial–temporal advantage near the ball allow to create some instabilities and transitions on patterns of play on attackers (when searching for the optimal pitch position to shot at the goal) and defenders (when protecting the scoring goal and recover the ball possession) (Vilar, Araújo, Davids, & Bar-Yam, 2013).

Tactical behavior in team sports has been evaluated in previous research by tracking the movement behaviors of players on the pitch. Afterwards, players positioning on the pitch were converted on variables that allow capturing the patterns of coordination between players and teams. For example, measuring the oscillation between the centers of gravity of teams (CG) it was possible to better understand the balance between teams on the field, the variation on the flow of the game and the level of coupling between teams (Frencken, Lemmink, Delleman, & Visscher, 2011; Lames, Erdmann, & Walter, 2010; Sampaio & Maçãs, 2012). The variation on the distance between CG of both teams also revealed interesting issues related with the emergence of goal scoring opportunities and assistant passes for shooting at goal (Duarte et al., 2012; Lames et al., 2010). Also, the covered areas, the stretch index and the relative stretch index provide accurate information about how attacking and defending teams expand and contract relative to one another over the game, allowing to understand the emergence of goal scoring opportunities or assistant passes for shooting situations (Duarte et al., 2012; Frencken et al., 2011; Lames et al., 2010).

Available research have highlighted relevant tactical team behaviors that coaches need to attend in order to improve players and teams' performance or to implement effective pedagogical strategies in SSGs (Davids et al., 2013; Travassos et al., 2013). Indeed, to optimize game adapted behaviors, coaches need to manipulate task constrains that highlight the information that sustain the emergence of functional patterns of coordination, such as the numerical relation between players, the number and size of the scoring targets or even its location.

However, only a few studies have measured how manipulating task constraints in SSGs changes tactical behavior of players and teams. The first one, measured the effects of the manipulation of the number of players (3 vs 3 and 4 vs 4) and their age (U9, U11 and U13) on interpersonal relation between teams (Folgado, Lemmink, Frencken, & Sampaio, 2012). The second, measured how the manipulation of the defensive playing method (zone or man-to-man defence) influenced the collective synchrony of football players during a 6 vs 6 SSG (Duarte, Travassos, Araújo, & Richardson, 2013). The third, measured the effect of changing game pace (slow, normal or fast), status (winning and losing)

and team balance (overloaded and underloaded) in 5 vs 5 SSGs (Sampaio, Lago, Gonçalves, Maçãs, & Leite, 2013). More recently, Vilar, Duarte, Silva, Chow, and Davids (2014) analyzed the influence of pitch dimensions in SSGs on the emergence of passing and shooting opportunities and Silva et al. (2014) analyzed the manipulation of team balance (overloaded and underloaded) and players' skill level (national and regional league players) on patterns of play of teams.

The manipulation of the scoring targets is often used during training sessions to constraint small-sided games with implications on physical and technical demands (Duarte et al., 2010; Fenoglio, 2003; Hill-Haas et al., 2011). The changes on the scoring targets location or the number of scoring targets amplified or reduced exposure to information that players use to explore possibilities for action over the game (Davids et al., 2013). Accordingly, the increase on the number of scoring targets on SSGs amplified the information that attackers need to account to shoot at goal by increasing the number of shooting lines that constantly appear and disappear (see upper panel of Fig. 1). In opposition, with higher number of scoring targets the defenders are exposed to amplified information that they need to account to not allow the appearance of shooting opportunities for attacking team. Increasing the number of scoring targets leads to a competition between opportunities for action and changes the spatial–temporal relations that players needs to account to successfully perform.

Previous analysis of the spatial–temporal principles that shaped successful passing interceptions showed that more passes were intercepted when the defenders were further away from the ball carrier and closer from the passing trajectory of the ball (Travassos et al., 2012). Also, the analysis of the spatial–temporal principles that shaped successful shoots interceptions revealed that defenders seek to maintain his position between the ball and the goal, not allowing a misalignment between the ball and the goal (Vilar et al., 2012). Consequently, following the informational constrains that sustain successful passes/shoots at goal vs interceptions of passes/shoots at goal, changes on emergent spatial–temporal interactions and the consequent patterns of coordination between teams are expected between game conditions, specially due to the high constraint that the increase on scoring targets represent to defending team in relation the ball position (Vilar, Araújo, Travassos, & Davids, 2014). Additionally, these constraints are likely promoting changes in the breadth of attention, and in tactical behavior of players (Memmert, 2007). In fact, breadth of attention refers to the number of information constrains that a participant has to manage simultaneously and its development is related to a greater variety of tactical decisions (Hüttermann, Memmert, & Simons, 2014; Memmert, 2007).

In this report, we first hypothesized that changing the number and size of scoring targets modifies the spatial–temporal relations that players needs to account to successfully perform. With the increase on scoring targets it was expected that defending teams decreases de space occupied on the field, and also increases the distance to opponent team in order to maintain his position between the ball and the goal, ensuring capability to successfully intercept the shoots at goal. Knowing that successful shoots were dependent of the capability of attacking team to promote misalignments between the ball and the goals positions, our second hypothesis is that changing the number and size of scoring targets promotes variations on the pitch zones explored by both teams to successfully perform (Carling, Wright, Nelson, & Bradley, 2013; McGarry, 2009). For that, we analyzed the tactical relations between teams on the entire pitch and on different game sectors and corridors for both SSG conditions. At the end, our third hypothesis is that changing the number and size of scoring targets modifies the players' breadth of attention, perceived stimuli and, consequently, the teams' tactical behavior during the football SSGs. For that we used a typical proposed manipulation on football practice tasks to improve the number of shoots at goal for the attack and the variation on the defensive covered area for defence (2 official scoring targets with goalkeeper vs. 6 mini scoring targets).

2. Methods

2.1. Participants

Twenty male senior professional players (mean age = 24.85, s = 4.1 years) participated in the study. The players were divided by the team coaches into four balanced groups of five players. All participants gave prior informed consent and all experimental procedures were approved by the Ethics Committee of the Research Center for Sport Sciences, Health and Human Development.

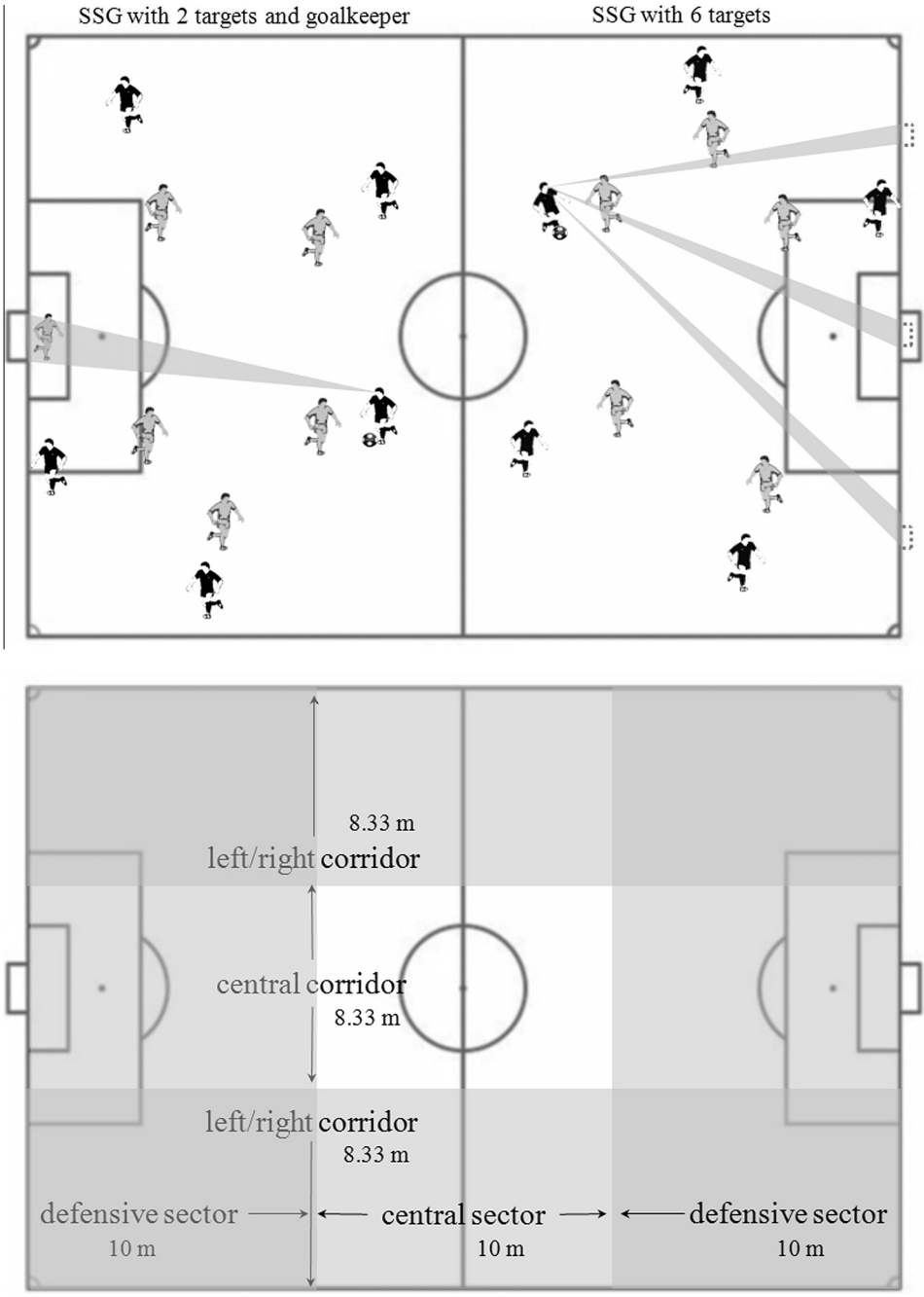

Fig. 1. Representation of SSGs game conditions with 2 targets with goalkeeper and 6 targets. The upper panel represents the number of possibilities for action of attackers when playing with 2 targets with goalkeeper and 6 targets. The lower panel represents the division of the pitch in corridors and sectors.

2.2. Data collection and analysis

Each team played two 5 vs 5 SSGs on a 30 × 25 m pitch in two different conditions: (i) with two official scoring targets (7.32 × 2.44 m) with goalkeeper (one for each team) and (ii) with 6 small scoring targets (1.20 × 0.80 m) (three for each team) (see Fig. 1). Each game was five minutes duration interspersed with a 3-min recovery period. A total of eight games were recorded for analysis, played during a normal training session, after a warming-up period of fifteen minutes consisting of running, stretching and a ball possession game at the normal training facilities.

Positional data were recorded at 15 Hz using a portable global positioning system (SPI-PRO, GPSports, Canberra, ACT, Australia) placed in the upper back of each player. Validity and reliability of these systems had already been provided (Coutts & Duffield, 2010). All the players used the same unit across games aimed to reduce measurement error (Jennings, Cormack, Coutts, Boyd, & Aughey, 2010). Positional data of players was used to determine the CG (i.e., the mean position data from the five players of one team), the stretch index of each team (STI) (i.e., the mean of the distances between each player and the CG for that team) (Lames et al., 2010), and the relative stretch index between teams (RelSTI) (i.e., the difference between the stretch index of each team) (Bourbousson, Sève, & McGarry, 2010) using dedicated routines in Matlab R2013b software (MathWorks, Inc., MA, USA). To generally describe how changes on the number of scoring targets constraint the spatial occupation of players and teams on the pitch, all data was analyzed considering the position of the CG of both teams over the entire pitch. After that, the DistCG and RelSTI were also measured according to the teams' pitch location in order to improve the understanding of the inter-team relations that support the requirements of each SSG. To measure the changes in inter-teams' patterns of play according to the pitch zones occupied, the entire pitch was divided in 3 equivalent longitudinal corridors: left wing, central corridor and right wing, and 3 equivalent lateral sectors: defensive sector of team A, central sector, and defensive sector of team B (see lower panel of Fig. 1). Data were grouped accordingly to each corridor or sector, based on the following rules: (i) left or right wings – at least one CG was on that wing, (ii) central corridor – the CG of both teams were on the central corridor; (iii) defensive sector of team A and B – the CG of the correspondence defensive team was on that sector; (iv) central sector – the CG of both teams were on the central sector, and then averaged separately for each pitch zone. In order to understand effectively how the manipulation on the number of scoring targets constraint the pitch zones occupied over the games, the percentage of total time played in each corridor and sector in each condition was calculated.

Differences between SSGs with 2 (considered baseline) and 6 scoring target were assessed independently for entire pitch and for each defined pitch zone via standardized differences with pooled variance, derived from the mean and standard deviation of each variable, with 95% Confidence Intervals (95% CI). The magnitude thresholds for mean differences were 0.20, 0.60, 1.2, 2.0 and 4.0 for small, moderate, large, very large and extremely large, respectively (Hopkins, 2010). Summary measures were calculated using random-effects models that consider both within-analysis and between-analysis variations (Cumming, 2012).

3. Results

The percentage total of time played in each corridor and sector revealed several differences between SSGs with 2 and 6 targets (see Table 1). There was a higher percentage of time played in central corridor and sector than on left/right corridor and defensive sector. From the total time that teams used to play in each corridor, there was a lower value in left/right corridors when 2 scoring targets were used (41.07%) in comparison with 6 scoring targets (58.93%). However, no difference in percentage of time played in central corridor was identified (50.43% and 49.57% for 2 and 6 scoring targets, respectively). From the total time that teams used to play in each sector, there was a higher value in central sector when 2 scoring targets were used (64.52%) in comparison with 6 scoring targets (35.48%). In opposition, it was identified a lower value in defensive sector when 2 scoring targets were used (20.97%) in comparison with 6 scoring targets (79.03%) (see Table 1).

Table 1
Percentage of total time played in each pitch zone and when the SSGs' were played with 2 and 6 scoring targets (%).

Pitch zone	Total	2 scoring targets	6 scoring targets
Corridor			
Central	90.19	50.43	49.57
Left/right	9.81	41.07	58.93
Sector			
Central	65.62	64.52	35.48
Defensive	34.38	20.97	79.03

The descriptive analysis (mean, standard deviation) of the positional variables according to the constrained SSGs with 2 and 6 targets is presented in Table 2. The standardized differences and 95% CI between SSG's are represented in Fig. 2, in which the shaded areas indicate thresholds of the observed magnitude effects between situations.

On the full pitch analysis the spatial occupation of players and teams revealed moderate differences for the variable STI (−0.52, 95% CIs, [−0.55, −0.49]) with higher values for 2 scoring targets SSG, and for the variable DistCG (0.86, 95% CIs, [0.81, 0.90]) but with higher values for 6 scoring targets SSG. A small difference with higher values for 2 targets game was observed for RelSTI (−0.28, [−0.31, −0.24]) (see Fig. 2). While an increase on the distance between teams (DistCG) was observed from 2 to 6 targets games, it was observed a decrease on the space occupied for both teams on the pitch (STI) and a decrease on the difference of space occupied between teams (RelSTI) from 2 to 6 targets game (see Table 2 and Fig. 2).

The changes on inter-teams relations according to the pitch zones revealed differences on patterns of play between the 2 and the 6 targets games, especially for DistCG on left/right corridors and defensive sectors (see Fig. 2). The analysis of pitch zones by corridors revealed that, when the CG of both teams were in the central corridor, a moderate effect was observed, with higher values for 6 scoring targets game (0.69, [0.64, 0.73]), while when the CG of one team was in a left or in a right wing, a large increase in DistCG occurred, with higher values for 6 targets game (1.75, [1.63, 1.88]) (see Fig. 2). The analysis of pitch zones by sectors revealed that, when the CG of both teams were in the central sector or in a defensive sector, a moderate increase was observed with higher values for 2 targets game (0.64, [0.58, 0.70] and 0.95, [0.87, 1.04], respectively), but with high values on defensive sector in comparison with the central sector (see Fig. 2).

For the variable RelSTI, the analysis by pitch zones revealed differences on patterns of play between the 2 and the 6 targets games, but with low magnitude than the differences previously observed for

Table 2
Descriptive analysis of the positional variables according to the SSG's with 2 and 6 targets (mean ± stand. deviation) (meters).

Pitch dimension	Variables	2 scoring targets	6 scoring targets
Full pitch			
	STI	7.43 ± 1.56	6.65 ± 1.37
	DistCG	3.48 ± 1.52	4.79 ± 1.95
	RelSTI	2.09 ± 1.33	1.72 ± 1.14
Corridor			
Central	DistCG	3.47 ± 1.48	4.49 ± 1.78
	RelSTI	2.08 ± 1.34	1.95 ± 1.40
Left/right	DistCG	3.70 ± 1.96	7.15 ± 1.61
	RelSTI	2.18 ± 1.16	1.80 ± 1.25
Sector			
Central	DistCG	3.48 ± 1.51	4.44 ± 1.88
	RelSTI	2.12 ± 1.33	1.88 ± 1.32
	Speed CGs	1.07 ± 0.63	0.96 ± 0.59
Defensive	DistCG	3.54 ± 1.62	5.09 ± 1.97
	RelSTI	1.86 ± 1.32	1.97 ± 1.44

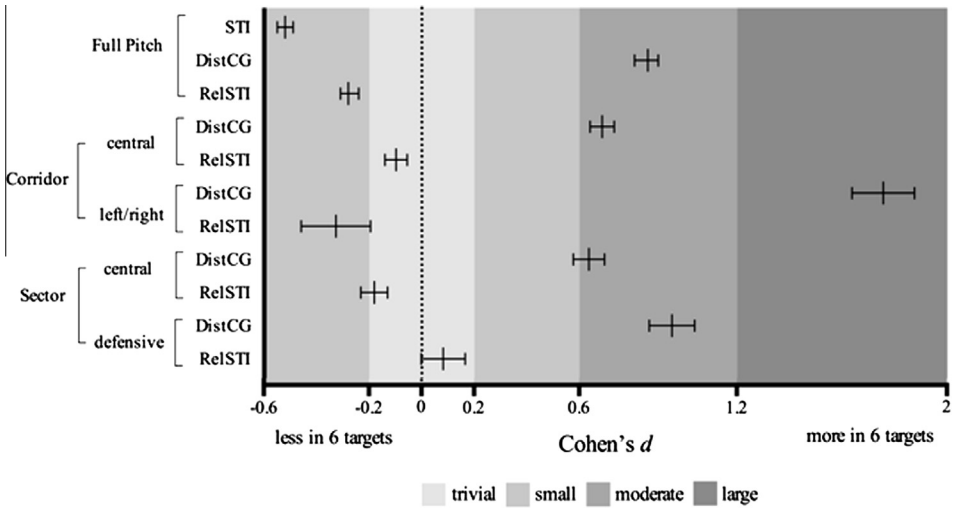

Fig. 2. Standardized differences and meta-analysis results between SSGs using 2 and 6 target games. The shaded areas indicate thresholds of the observed magnitude effects between game variables.

DistCG variable (See Fig. 2). The analysis of pitch zones by corridors revealed that, when the CG of both teams were in the central corridor, a trivial decrease was observed in RelSTI, with higher values for 2 targets game (−0.10, [−0.14, −0.06]), while when the CG of one team was in a left or in a right wing, a small decrease in the same direction occurred for RelSTI (−0.33, [−0.46, −0.20]) (see Fig. 2). The analysis of pitch zones by sectors revealed that, when the CG of both teams were in the central sector a trivial difference was observed in RelSTI, with higher values for 2 targets (−0.18, [−0.23, −0.13]), while in a defensive sector, a trivial difference was observed in RelSTI but with higher values for 6 targets game (0.08, [0.01, 0.17]), (see Fig. 2). When the game was played on the central sector with 2 targets, RelSTI revealed higher difference between the two teams than when played with the 6 targets. However, when the game was played on the defensive sector of one team, the 2 game targets revealed lower values on RelSTI than the 6 targets game (see Fig. 2).

4. Discussion

This study aimed to measure how changes on targets information (2 goals with goalkeeper vs. 6 goals) modify teams' tactical behavior during football SSGs. The results seem to confirm that using more targets in football SSG will modifies the spatial–temporal relations that players needs to account to successfully perform. Generally, we confirm our fist hypothesis revealing that the increase on the number of targets, promote increases on the distances between teams, and on the difference between the spaces used for both teams. The second hypothesis was also confirmed. With changes on the number and size of scoring targets variations on the pitch zones explored by both teams to successfully perform were also observed. Due to the changes on patterns of coordination between teams it seems that our third hypothesis can be also confirmed. Using more targets in football SSG likely expand the players' breadth of attention and perceived stimuli, thus, facilitating tactical performance. Previous laboratory-based research revealed a systematic association between the "shape" of focused attention in a laboratory task and expertise in a real-world skill (Hüttermann et al., 2014; Memmert, 2007). However, there are no studies conducted under game like conditions to identify the effects promoted by this constraint. Further research is needed in this domain.

The results revealed that the use of SSGs with additional small scoring targets promoted that teams played far away from each other with lower space covered and lower difference on the space covered between teams. Previously, Fenoglio (2003) reported that using a four scoring target SSG in a 4 vs 4

and 8 vs 8 game promoted more scoring attempts and more goals than using a 2 scoring target game with goalkeeper. Based on that, the increase on shooting possibilities on the 6 scoring targets SSG promotes the emergence of new patterns of play, due to the amplified exposure to information that players used to explore possibilities for action over the game. Teams' behavior was attracted to most functional patterns of coordination to maintain the spatial–temporal principles that shaped successful passes/shoots vs passes/shoots interceptions due to the changes on the local relations (Passos, Araújo, & Davids, 2013) imposed by the changes on the number of targets. Under the cooperation and competition between players of the same teams and the opponent team, in relation to the requirements of each SSG, the local relations are re-defined by the spatial–temporal information that comes from the distribution of players in the pitch in interaction with the ball kinematics and the scoring targets location (McGarry, 2009). Indeed, under the variability of possibilities for action, the constant co-adaptation between teams to achieve functionally a certain goal, promotes stabilization on behaviors under invariant local rules for each SSG (Passos et al., 2013).

With the increase from the number of shooting possibilities on the 6 scoring targets SSG, a co-adaptation on the offensive and defensive behavior led to the emergence of a new stable pattern characterized by higher distances and lower space between teams on the pitch (the invariant local rules that characterizes the game dynamics). According with previous research, a decrease on the distance between teams promoted perturbations on balance between teams score goals or to recover ball possession (Duarte et al., 2012). The use of a 6 scoring target SSG seems to promote higher security on the spatial proximity between teams, allowing lower space occupied for both teams on the pitch and lower differences between teams. Besides the amplification on the information to shoot at goal, the team with ball possession needs to keep in mind the protection of their goals if a change on ball possession occurs. The number of opportunities for action also increased for the opponent team, when playing with 6 targets if team in ball possession loses the ball. That is, the increase on the distance between CG resulted in more equilibrium in the space covered by both teams, accordingly to the position of the ball and the goals, as previously reported (Vilar, Araújo, et al., 2014). As occurs when playing in underloaded numerical relation (Silva et al., 2014), by decreasing the amount of space that the team needs to cover, the defending team restricts the shooting or passing lines opportunities that emerge over the game not allowing misalignments between the ball and the goals or the attackers that can receive the ball (Travassos et al., 2012; Vilar et al., 2012).

The effect of pitch location on the patterns of play revealed interesting results. Dominance of play was on the central corridor and on the central sector. However, from the time played in left/right corridors, about 59% was played in the SSG with 6 scoring targets. Also, from the time played in defensive sectors, about 79% was played in the SSG with 6 scoring targets. These results seem to suggest that manipulating the number of scoring targets from 2 to 6, increased the percentage of time that teams displayed in lateral corridors and especially on defensive sectors. Thus, the changes on the number of scoring targets on SSGs demands new adaptations not only on the spatial–temporal relations between teams, but also on the pitch locations that teams used to explore their possibilities for action (e.g., misalignments between defending team and goals).

In the lateral corridors the higher increase on the distance between geometrical centers of both teams, and the higher decrease on the relative stretch index were observed. Indeed, the development of the game in lateral corridors changed the local rules, i.e., the spatial–temporal relations between teams, by changing the position of the ball in relation to the scoring targets location allowing the emergence of new functional patterns of coordination. As expected, the management of the angle between ball position and the scoring target in relation to defensive team position, that in the 6 scoring target SSG was amplified, is a key issue to protect the goal and not allow the emergence of possibilities to shoot at goal (Travassos, Araújo, Duarte, & McGarry, 2012; Vilar et al., 2012).

When the teams played in defensive sectors, it was observed a moderate increase on the distance between geometrical centers with a trivial increase on the relative stretch index from 2 to 6 scoring targets. Therefore, it is suggested that additional number of targets promoted higher differences on covered space between attacking and defending teams. Also, according to the increase on the percentage of time that teams displayed in defensive sector when played in the 6 scoring targets SSG, it seems that defensive team retreats the position on the pitch to account with the advantage of defending three scoring targets instead of one as occur on official games. The increase on the time dis-

played on the defensive sector, in the 6 scoring targets SSG, linked with the higher distances and the lower space occupied between teams seeks to limit goal scoring opportunities by reducing the spaces surrounding the scoring goals (Travassos, Vilar, Araújo, & McGarry, 2014; Vilar, Duarte, et al., 2014).

These results provide empirical confirmation to the expectancies of Carling et al. (2013) and McGarry (2009), when suggesting the need to measure and analyze teams' and players' behavior accounting for pitch location. In effect, pitch location not only constrained the local players relations between attackers and defenders (Headrick et al., 2011) but also the relationship developed between teams. Future research on the analysis of tactical behaviors of players and teams in football needs to account for this important issue.

5. Conclusions

Summarizing, the manipulation of the number of scoring targets from 2 to 6 on football SSGs demands adaptations between teams not only on the spatial–temporal relations, but also on the pitch locations that teams used to explore their relations. The amplification of the information on the 6 scoring targets SSG, led the emergence of higher distances between teams and lower space occupied between them on the pitch. An increase on the time that teams displayed on lateral corridors and defensive sectors were observed on the 6 scoring targets in comparison with the 2 scoring targets SSG. When teams played in lateral corridors or in defensive sectors, the increase on the distance between teams and the decrease on the space occupied between them were highlighted from 2 to 6 scoring targets SSGs. Future analysis of tactical behaviors of players and teams in football needs to account with the effect of pitch location on players and teams behavior. This study has clear implications for practice as emphasizes that amplification of specific information on SSGs can help coaches to expand the players' breadth of attention and perceived stimuli, thus, facilitating tactical performance. Further research is needed in this domain for the identification of the effects and transference of these capabilities for the performance context. Also, future research needs to consider the manipulation of the number of goals and the presence or absence of goalkeeper independently for a clear cause-effect relationship on the patterns of play observed.

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