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CAN JOKER PLAYERS FAVOR THE EXPLORATORY BEHAVIOUR IN FOOTBALL SMALL-SIDED GAMES?

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(Original scientific paper)

Angel Ric[1], Robert Hristovski [2] & Carlota Torrents[1]
[1]National Institute of Physical Education of Catalonia (INEFC), University of Lleida, Lleida, Spain
[2]Faculty of Physical Education, Sport and Health, Ss. Cyril and Methodius University, Skopje, Macedonia

Abstract
Football coaches usually introduce joker players during training drill. Common drills used in football are small-sided games (SSG) in order to reproduce the game but reducing the number of players, space and play time from the real match. This is a largely under-explored type of training method especially with respect to the question of its contribution in improving the tactical problem-solving skills and behaviour in players. The aim of this study was to preliminary identify how joker players may influence the exploratory efficiency of player's tactical behaviour during SSG. To analyse it some simulations were created by systematically mixing experimentally obtained sequences of action configurations (patterns) with different time length performed during SSG developed under imbalanced conditions. Results confirmed that the timescale of tens of second is an optimal range on which the use of joker players can enlarge the breath of exploration of football players. This research provides a new rationale for involving joker players in practice task design.

Key words: *Time-scales, tactical behaviour, variability, task constraints, small-sided games*

Introduction

Small Sided Games (SSG) is a common drill used during football training sessions. Usually this kind of drill has been used to increase the physical and physiological performance of players (see e.g. for review Hill-Haas, Dawson, Impellizzeri, & Coutts, 2011). During the last years, however, research has been increasingly focused on understanding how different manipulations of constraints within SSG, including the size of playing area, the number of ball touches, presence or absence of goalkeepers, absence or encouragement from the coach (for review see Aguiar et al., 2012),influence the tactical behaviour on collective and individual level. It has been reported that SSG training may not always simulate the high-intensity, repeated sprint demands of high-level competition (Gabbett et al., 2009), but there may exist an increase in the number of technical actions performed in SSG. Also this game formats can provide help on the tactical level, defined as the coordinated behaviour of three or more players looking to cooperate and compete together through synergistic relations to achieve common goals (Silva, 2014). In this way, Aguiar and colleagues (2015) showed that under the balanced numerical relation of players, there is a direct proportional relation of the change of the number of players involved in the game with the positional inter-team coordination.

SSG are representative of the unstable, dynamic and unpredictable nature of team competitive game (Davids et al., 2013). During the game and training drill, under the interaction of a set of constraints (personal, task and/or environmental) some behaviours are more probable than others. In other words, depending on the task constraints, a variety of interlinked intention-attention-decision-action patterns on different timescales can be elicited in players. Hence, the larger exploration the game offers the more varied perception-action and problem-solving patterns the player experiences in a certain time interval. Coaches usually manipulate task constraints as a powerful tool available for improving the player's decisions and actions in a performance context (Passos et al., 2008). Players can discover and learn a large set of possibilities to act, performing task-solutions by functionally adapting their behaviour to the actions of their teammates and opponents. In this sense, SSG similarly to full games, provide a continuous exploration, discovery and learning of player's actions supported by immediate *affordances*, i.e. opportunities for action.

The exploratory activity has been defined as a subsequent realization of a set of performer-environment action, i.e. problem-solving, configurations (Hristovski et al., 2012). This concept is also relevant in team games, which form improvisation contexts underpinned by the interaction between players. Training methods should thus seek to promote the exploration within different game contexts. Recently it has been demonstrated that relaxing task constraints enables larger exploratory capacity and varied behaviour to emerge for the athletes and dancers (Pinder et al., 2012; Torrents et al., 2015). Then, due to the large set of perception-action degrees of freedom that any performer-environment system contains, coaches should find and manipulate those constraints, which maximizes the functional action versatility (Hristovski et al., 2013). All this brings us to the question of how to increase the exploratory efficiency of players as defined by the maximization of exploratory context of the game per unit of time.

Following the idea of these previous studies, Ric and colleagues (in press) studied how changing the number of opponents during SSG, considered as a task constraint, influences the exploratory breadth of players and the timescales where the exploratory tactical behaviour stop to increase and becomes constant on average. The authors showed that the exploratory behaviour of players changed in quantity and quality (i.e. types of most probable tactical configurations) as a function of the players numerical imbalance. The exploratory breadth became close to constant on the time scale of few tens of seconds. One practical suggestion of this work was that constraining the game by using joker players which would enter and exit the game on the timescale of few to several tens of seconds could enlarge the breadth of exploration. Using joker players is a common practice during training sessions, however few investigations have been performed on this issue. To our knowledge, the sole study that investigated the influence of jokers was focused on the effects on time-motion characteristics and acute physiological and perceptual responses in different SSG formats (Hill-Haas et al., 2010). They reported that in game formats where joker players were used (3 vs. 3 + joker player and 5 vs. 5 + joker player) the total distance travelled and the rating of perceived exertion were significantly higher than during SSG with fixed imbalance condition (6 vs. 5 and 4 vs. 3). There were no differences in high intensity running, percentage of maximal heart rate and blood lactate. Other researchers, as well, have recommended the presence of joker player(s). Bourbousson and colleagues (2014) demonstrated that the action of a drive in real basketball match was based on the dynamics at the team level and not at the dyadic level (i.e. one-to-one setting). For this reason, they proposed a task design that increases the representativeness of team competitive games nature (Davids et al., 2013; Silva, 2014). A joker player who supported the team with ball possession was involved in the task to disrupt the dynamics of the relative phase of the attacker-defender dyad. The role of this joker player constrained the game by forcing the defender player to adapt to a new game context.

Following these results, the aim of this study was to investigate the possible effects of manipulation of numerical imbalance on different time intervals as proposed by Ric and colleagues (in press), and detecting an optimal range for manipulating practice task constraints between teams engaged in SSG by using joker players.

Method

Data from Ric et al, in press, was used to simulate the change in the number imbalance of players on the scale of tens of seconds. In that study three different SSG were designed: 4vs3, 4vs5, 4vs7 plus a goalkeeper with each team but goalkeepers were excluded from the analysis. Two teams of four players were analysed for the aims of that study. The data collected for each player yielded Boolean data vectors derived from 37 categories, which belonged to the following four categories: tactical actions, inter-player context, pitch zones and movement speeds; representing the full action configuration during the same time interval (1 second) (See Ric et al, in press, for details). The value of 1 was ascribed to the active category and a value of 0 to the inactive one. Finally, a Boolean matrix of size 37 rows x 360 columns (variables) was obtained for each player.

The data from those experimentally obtained SSG multivariate time series was cut in periodic blocks of 15, 30, 45 and 60 seconds. The periodic blocks were mixed following the sequence: 4vs3, 4vs5, 4vs7, 4vs3, 4vs5, 4vs7… to a total of 360 seconds, keeping the time points, i.e. order, from which they were extracted. For example, from second 1 to 15 of 4vs3 – from second 16 to 30 of 4vs5 – from second 31 to 45 of 4vs7 – from second 46 to 60 of 4vs3 – ... – from second 345 to 360 of 4vs7.

To identify the exploratory breadth of each player during the different game context the dynamic overlap $\langle q_d(t) \rangle$ was calculated as an average cosine auto-similarity of the overlap between configurations with increasing time lag to determine the asymptotic (i.e., stationary) value of the dynamic overlap (see Torrents et al., 2015, Hristovski et al, 2013 for details). Data were analysed by using dedicated routines in Matlab R2014a software (MathWorks, Inc., Massachusetts, USA). To calculate the mean of the asymptotic value of <$q_d(t)$> a range from the 15 point time lag to 180 time lag was selected for each player. The Quasi-Newton fit of the theoretical curve to the experimental data was used.

The data are reported as means ± standard deviation (SD). ANOVA with repeated measures (RM ANOVA) was used to compare the SSG without simulated joker players and within on different timescales of tens of second. If the sphericity assumption in RM ANOVA was violated (Mauchly's test), the corrected tests of significance were used (Huynh & Mandeville, 1979). Partial eta square ($_p\eta2$) value is reported as measures of effect size, with moderate effects considered for $_p\eta2 = 0.07$ (Cohen, 1988). Tukey HSD tests were used as post-hoc tests following significant main effects. To reduce bias arising from non-uniformity error, data were log-transformed. Uncertainty in the differences was expressed as 90% of confidence limits (CL) and as probabilities that the true effect was substantially greater or smaller than the smaller practical difference (between-subjects). These probabilities were used to make a qualitative probabilistic mechanistic inference about the true effect. The scale was as follows: 25−75 %, possible; 75−95 %, likely; 95−99 %, very likely; > 99 %, most likely. The Cohen'd effect size with 90 % CL were calculated using pooled standard deviation for the comparisons and the magnitude ranges for mean differences were: 0-0,2 trivial; > 0,2 – 0,6 small; > 0,6 – 1,2 moderate; > 1,2 – 2 large; > 2 very large (Hopkins et al., 2009).

Results

Figure 1 shows the dynamic overlap <$q_d(t)$>, and the averages of the stationary part, <q_{stat}>, for each constraint, comparing the values of playing with the same number of opponent lasting six minutes with the simulations of changing the number opponent players on different time periods in the scales of tens of seconds. The goodness of fit of all time series between the theoretical curve following the equation: <$q_d(t)$> = $(1 - q_{stat}) t^{-\alpha} + q_{stat}$, and the experimental data (N = 165) for the exploratory dynamics, remarkably, accounted for 96,37 ± 0,79 % of variance. The average dynamic overlap would be a constant equal to 1 (i.e., <q_{stat}> = 1) for all time lags if players maintained the same action configuration during entire playing time. On the other hand, if the players explored all possible contextual configurations of the whole theoretically possible action state space, then the <q_{stat}> value would be 0.

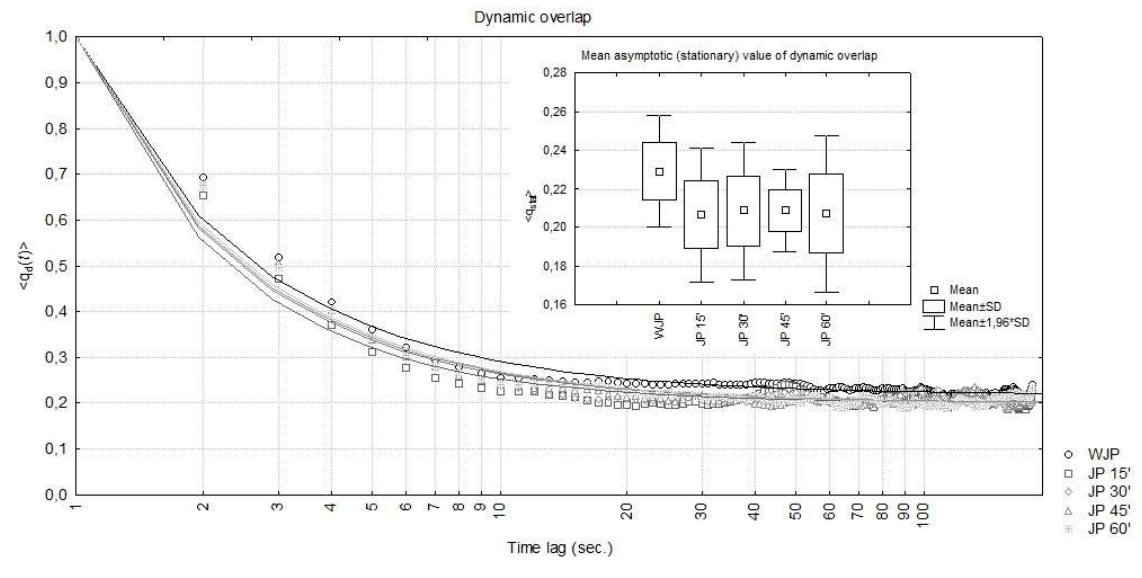

Figure 1. Profile of the average dynamic overlap <$q_d(t)$> for each condition. Right upper panel: mean and standard deviations (SD) of the exploratory breath <q_{stat}> of each condition. WJP – without joker players; JP 15' – change of the number of joker players every 15 seconds; JP 30' – change of the number of joker players every 30 seconds; JP 45' – change of the number of joker players every 45 seconds; JP 60' – change of the number of joker players every 60 seconds; Note: Lower values of the dynamic overlap correspond to higher exploratory breadth.

RM ANOVA revealed a significant main effect of the change of the numerical imbalance on the mean stationary value on the dynamic overlap for conditions: fixed number of opponents during the whole 6 minutes game vs numerical change of opponent jokers on different time periods at the timescale of tens of seconds: [F (3,844; 0,000) = 9,240; p = 0,0001; $_p\eta^2 = 0,569$]. Post-hoc Tukey HSD comparisons showed similar results (see Table 1).

Table 1. Mean differences of the stationary overlap values <q_{stat}> when changing numerical imbalance in SSG on short time scale, i.e. tens of seconds by using jokers, and fixed numerical imbalance over 6 minutes.

SSG	Mean±SD	Comparisons	Tukey HSD test	Difference in means %; ± 90 CL	Uncertainty in the true differences	Cohen's d; ± 90 CL
WJP	0,23±0,01					
JP 15'	0,21±0,02	a)	p < 0,001	-9,91; ±4,24	most likely ↑	-1,50 ±0,68
JP 30'	0,21±0,02	b)	p < 0,001	-9,06; ±2,84	most likely ↑	-1,36 ±0,45
JP 45'	0,21±0,01	c)	p < 0,001	-8,86; ±2,70	most likely ↑	-1,33 ±0,43
JP 60'	0,21±0,02	d)	p < 0,001	-9,81; ±2,83	most likely ↑	-1,48 ±0,45

WJP – without joker players; JP 15' – change of the number of joker players every 15 seconds; JP 30' – change of the number of joker players every 30 seconds; JP 45' – change of the number of joker players every 45 seconds; JP 60' – change of the number of joker players every 60 seconds; Note: Lower values of the stationary overlap correspond to higher exploratory breadth.

Discussion

In this study, we sought an answer to the question whether changing the game numerical imbalance context by using opponent joker players who enter and leave the game over the time scale of tens of seconds will promote an increased players' tactical exploratory behavioural efficiency as compared to the mean exploratory behaviour of playing SSG with fixed (4vs3; 4vs5 and 4vs7) numerical imbalance design over 3 x 2 = 6 minutes.

Coaches perform usually SSG because are representative of real game. However, previous results had demonstrated that during full games the teams with numerical local dominance, i.e. allocated more players than their opponents in sub-areas of play, achieved to keep defensive stability when they did not have the ball possession and create opportunities to goal in attacking phase (Villar et al., 2012). In that sense, the use of joker player(s) promotes the rotation of numerical dominance on both game phases (offense and defence). The changing environment constrains players to explore more task-solutions and consequently enlarge their exploratory breadth of tactical behaviour.). Under the fixed numerical imbalance constraints emerges a typical landscape of action configurations. These configurations are characterized by individual actions with ball and defending skills in opponent field when numerical superiority, and space control close to the own goal defence. Demarks are only performed in offence when played in inferiority (Silva, 2014; Ric et al, in press). The use of an opponent joker, entering and leaving the game, amplifies the quantity of information as well as affordances to be perceived, resulting in exploration of task solutions and different tactical behaviours (Travassos et al., 2014).

Our results showed that simulations of using opponent jokers form representative scenarios close to those characteristic of a full game. This intervention aims at perturbing the game at the scale when the exploratory behaviour sufficiently saturates instead of waiting three or six minutes to change the task constraint (i.e. the numerical imbalance). It increases the variability of tactical problems to be solved by players per time unit. Hence, the manipulation of numerical advantage and lower/ larger numerical disadvantage over different intervals of tens of seconds scale may help in enlarging the exploratory behavioural efficiency of players.

Conclusion

This study was a preliminary attempt to determine the optimal range of time scales for manipulating practice task constraints based on the numerical relationship between teams engaged in SSG. The results showed that the changing of numerical imbalance through the use of jokers can be applied over the time scales on which exploratory behaviour saturates under fixed numerical task constraints (i.e. 15, 30, 45, 60 seconds) to enlarge the varied task solutions of players and their exploratory breadth in a reduced time interval. Further research is warranted in order to find out how different roles of joker players (external and internal jokers on the playing space, jokers who systematically play with the attacking team, for example) can influence the tactical behaviour and whether it enhances the exploratory breadth of football players in different practice tasks.

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