Original article (short paper)

Inspecting the performance of neutral players in different small-sided games

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Abstract—The aim of this study was to inspect the effects of format and task conditions on neutral players' heart rate responses and time-motion characteristics. Four formats of play using neutral players and three task conditions were inspected. Moreover, the factor repetition (3 games per each SSG) was also analysed. Ten male amateur soccer players (26.36 ± 5.33 years old, 8 ± 3.2 years of practice, 66.18 ± 10.16 bpm at rest) participated in this study. The repeated measured revealed that no differences were found between repetitions (*Pillai's Trace* = .075; $F_{8, 100}$ = 1.007; *p-value* = .436; = .075; *Power* = .445; small effect size). In the game 1 significant interaction effects between the two factors on heart rate responses and time-motion profiles were observed (*Pillai's Trace* = 0.699; $F_{24,428}$ = 3.774; *p-value* = .001; = .175; *Power* = 1.000; moderate effect size). In the game 2 , significant interaction effects between the two factors on heart rate responses and time-motion profiles were observed (*Pillai's Trace* = .712; $F_{24,428}$ = 3.860; *p-value* = .001; = .178; *Power* = 1.000; moderate effect size). Finally, in the game 3 significant interaction effects between the two factors on heart rate responses and time-motion profiles were observed (*Pillai's Trace* = .729; $F_{24,428}$ = 3.972; *p-value* = .001; = .182; *Power* = 1.000; moderate effect size). Briefly, it was possible to conclude that the biggest formats statistically increased the heart rate responses and time-motion characteristics of neutral players. It was also possible to observe that the mean values of heart rate responses found in neutral players throughout small-sided games were appropriated to very light or recovery workouts.

Keywords: soccer, small-sided games, task conditions, performance, neutral players

Resumo—"Avaliando o desempenho de jogadores neutros em diferentes jogos reduzidos." O objetivo deste estudo foi avaliar os efeitos do formato e condições da tarefa nas respostas cardíacas e perfis de movimento de jogadores neutros. Adotaram-se quatro formatos de jogo e três condições da tarefa utilizando jogadores neutros. Participaram no estudo dez jogadores de futebol amador (26,36 ± 5,33 anos de idade, 8 ± 3,2 anos de prática, 66,18 ± 10,16 bpm em descanso). O teste de medidas repetidas não mostraram diferenças estatisticamente significativas entre repetições (*Pillai's Trace* = 0,075; $F_{8, 100}$ = 1,007; *p-value* = 0,436; = 0,075; *Power* = 0,445). No jogo 1 identificaram-se diferenças estatisticamente significativas na interação entre factores nas variáveis de frequência cardíaca e velocidade (*Pillai's Trace* = 0,699; $F_{24,428}$ = 3,774; *p-value* = 0,001; = 0,175; *Power* = 1,000). No jogo 2 identificaram-se diferenças estatisticamente significativas na interação entre factores nas variáveis de frequência cardíaca e velocidade (*Pillai's Trace* = 0,712; $F_{24,428}$ = 3,860; *p-value* = 0,001; = 0,178; *Power* = 1,000). Finalmente, no jogo 3 identificaram-se diferenças estatisticamente significativas na interação entre factores nas variáveis de frequência cardíaca e velocidade (*Pillai's Trace* = 0,729; $F_{24,428}$ = 3,972; *p-value* = 0,001; = 0,182; *Power* = 1,000). Concluiu-se com este estudo que os formatos maiores aumentam estatisticamente a resposta cardíaca e o perfil de movimento de jogadores neutros. Foi igualmente possível observar que os valores médios de frequência cardíaca encontrados em jogadores neutros são apropriados para trabalhos de baixa intensidade ou de recuperação ativa.

Palavras-chave: futebol, jogos reduzidos, condições da tarefa, desempenho, jogadores neutros

Resumen—"Evaluación del rendimiento de los jugadores neutros en diferentes juegos reducidos." El objetivo de este estudio fue evaluar los efectos de formato y de tareas en condiciones respuestas cardíacas y el movimiento de perfiles de los jugadores neutrales. Se utilizaron cuatro formatos de juego y tres condiciones tarea utilizando jugadores neutrales. Participó en el estudio, diez jugadores de fútbol (26,36 ± 5,33 años de edad, 8 ± 3,2 años de práctica, 66,18 ± 10,16 lpm en reposo). La prueba de medidas repetidas mostró diferencias estadísticamente significativas entre repeticiones (*Pillai's Trace* = 0,075; $F_{8, 100}$ = 1,007; *p-value* = 0,436; = 0,075; *Power* = 0,445). En lo juego 1 hubo diferencias estadísticamente significativas entre los factores (*Pillai's Trace* = 0,699; $F_{24,428}$ = 3,774; *p-value* = 0,001; = 0,175; *Power* = 1,000). En lo juego 2 hubo diferencias estadísticamente significativas entre los factores (*Pillai's Trace* = 0,712; $F_{24,428}$ = 3,860; *p-value* = 0,001; = 0,178; *Power* = 1,000). En lo juego 3 hubo diferencias estadísticamente significativas entre los factores (*Pillai's*

Trace = 0,729; $F_{24,428}$ = 3,972; *p-value* = 0,001; = 0,182; *Power* = 1,000). Se concluye de este estudio que los formatos más grandes estadísticamente aumentan respuesta cardiaca y el perfil de movimiento de jugadores neutrales. También se observó que los valores promedio de la frecuencia cardíaca que se encuentran en los jugadores papeles neutros son adecuados para baja intensidad o de recuperación activa.

Palabras claves: fútbol, juegos reducidos, condiciones de la prática, rendimiento, jugadores neutros

Introduction

Small-sided games (SSG) are part of a training strategy that coaches use to improve the practice of soccer (Little, 2009). In fact, the use of smaller games increases individual participation of players in a sport, and provides positive physiological outcomes (Clemente, Couceiro, Martins, & Mendes, 2012). In that sense, the SSG importance for soccer training is quite valuable and an interesting topic to be researched in sports sciences (Hill-Haas, Dawson, Impellizzeri, & Coutts, 2011).

The effects of SSG on players' responses can vary from game to game (Aguiar, Botelho, Lago, Maças, & Sampaio, 2012). Moreover, there are several task conditions that coaches manipulate in order to offer players a variety of stimulation (Owen, Wong, Paul, & Dellal, 2014). Task conditions such as field dimensions, format of games, specific rules or specific goals are commonly manipulated by coaches during sports training (Hill-Haas *et al*., 2011). Each task condition requires different performance of players. Therefore, research focus on the influence of each task condition on players' responses.

The format of the SSG is one of the task conditions most studied until now (Little & Williams, 2007; Owen, Wong, McKenna, & Dellal, 2011). The main findings reveal that smaller formats (*1v1*, *2v2* and *3v3*) statistically increase positive physiological responses relative to bigger game formats (*4v4*, *5v5* or *6v6*) (Dellal, Hill-Haas, Lago-Penas, & Chamari, 2011; Hill-Haas, Dawson, Coutts, & Rowsell, 2009; Köklü, 2012). In these studies, findings reveal values closer to 85–93% HR max in smaller games which is considered an appropriated anaerobic workout (Little, 2009). The bigger games (*4v4*, *5v5* or *6v6*) vary from 80–86% HR max that is more appropriated to high intensity aerobic workout (Little, 2009).

In the case of field dimensions, studies inspected the influence of smaller, medium or large dimensions in each SSG (Kelly & Drust, 2009; Rampinini, *et al*., 2007). The majority of studies have reported that bigger dimensions increase the physiological responses of players (heart rate responses and blood lactate concentration) (Kelly & Drust, 2009; Rampinini, *et al*., 2007). Moreover, the study of Casamichana and Castellano (2010) showed that the distance covered was greater in bigger fields, mainly the distance covered in high intensity running.

Other task conditions have also been studied such as the limitations of individual contacts on ball location (Dellal, Lago-Penas, Wong, & Chamari, 2011), goals (Duarte, *et al*., 2010), the non-use of goalkeepers (Mallo & Navarro, 2008) and the use of neutral players (Evangelos *et al*., 2012). From those task conditions, it was found that the limitations of touches per player, the non-use of goalkeepers or the non-use of goals increased the heart rate responses of soccer players. The use of neutral players is not consensual in the few studies that research the issue (Bekris *et al*., 2012; Evangelos *et al*., 2012). Nevertheless, the use of neutral players is widely used by coaches as a didactical strategy (Mitchell, Oslin, & Griffin, 2006). Such task conditions provide the offensive team or defensive team an additional player to perform the collective organization and to take advantage of the opponent. Despite the importance of this task condition, to our knowledge, no studies analyzed the influence of being neutral player in the SSG context.

Therefore, the aim of this study was to inspect the performance of neutral players[1] during different games. The study inspected the neutral players' responses in different games using four formats (*1v1*, *2v2*, *3v3* and *4v4*) and three task conditions (T1: no goals, but endline; T2: two smaller targets; and T3: one smaller target). The heart rate responses and time-motion characteristics were inspected throughout the all games.

Methods

Participants

Ten male amateur soccer players (26.36 ± 5.33 years old, 8 ± 3.2 years of practice, 179 ± 5.4 cm, 71 ± 7.1 kg, VO_2max of 45.81 ± 2.63 ml kg^{-1}min^{-1}, 66.18 ± 10.16 bpm at rest) from the Portuguese regional league participated in this study. The study was carried out respecting the Helsinki Declaration (Ethics Committee from Polytechnic Institute of Coimbra, approval # ESEC.O01.09.13).

In order to ensure the normality in players' lifestyle, they were asked to maintain normal daily food and water intake during the period of the study's intervention. Before the study, all players were familiarized with the experimental procedures. Players were also provided with the fundamental information about how to control the heart rate monitors. All players undergoing a training regime for three-months, carrying out soccer-specific training sessions lasting 70 to 90 minutes. Players participated in three training sessions per week plus one match.

Design

The aim of this study was to analyze the effects of different SSG formats (*1 vs. 1+2*, *2 vs. 2+2*, *3 vs. 3+2* and *4 vs. 4+2*)[2] and task conditions (scoring in the endline – T1, two targets – T2 and in a central target – T3) on heart rate response and time-motion profile of neutral players. These formats were selected due to their own characteristics to increase the individual participation in the task (technical actions). Moreover, following

[1] A player that is free to play with the team with possession of the ball.
[2] As example the 1 vs. 1+2 means that is a regular format 1 vs. 1 (one player against one player) plus two neutral players that give support to the team with possession of the ball

Table 1. Characteristics of the small-sided games.

Format	Task condition	Game duration (min)	Duration of recovery between SSG (min)	Field Dimensions (m)	Field Total Area (m^2)	Area per Player (m^2)
1v1+2	T1 T2 T3	3x2 min	2 min	16x11 m	176m^2	~90m^2
2v2+2	T1 T2 T3	3x3 min	3 min	19x19 m	361m^2	~90m^2
3v3+2	T1 T2 T3	3x4 min	4 min	23x23 m	529m^2	~90m^2
4v4+2	T1 T2 T3	3x5 min	5 min	27x27 m	729m^2	~90m^2

the international literature, these formats are similar regarding the heart rate responses and time-motion profiles (due to their categories - small games, not medium) (Clemente, Martins, & Mendes, 2014; Little, 2009); thus, it is important to identify what differences exist between games with similar effects. From the two variables, 12 games were carried out as seen in Table 1.

Only neutral players were considered for this study. The HR response, time-motion and technical/tactical variables were recorded throughout all sided games to examine and compare the activities of the players during the different SSG formats in three different task conditions. All players were tested during one session per each format used (playing the three task conditions); thus, the study was carried out for four consecutive weeks. In order to avoid circadian variation, the study was performed on the same day (Thursday) and at the same time each week. The day before data collection (Wednesday) was ensured to be a non-training session in order to allow recovery 24 hours between trainings. All training sessions were applied without wet conditions and with a temperature ranging from and . No sign of injury, illness or severe fatigue were found in players during the study.

Small-sided games

The task conditions were implemented in random order per each training session. Each game had two neutral players that only played on the sideline. In all formats, the neutral players (+2) only provided coverage to the players/team with ball possession. The neutral player was able to conduct the ball over the sidelines with a maximum number of touches to the ball (3) in order to put boundaries in the time of possession of the ball in the neutral player. For each format, three different task conditions depending on target were applied (Figure 1).

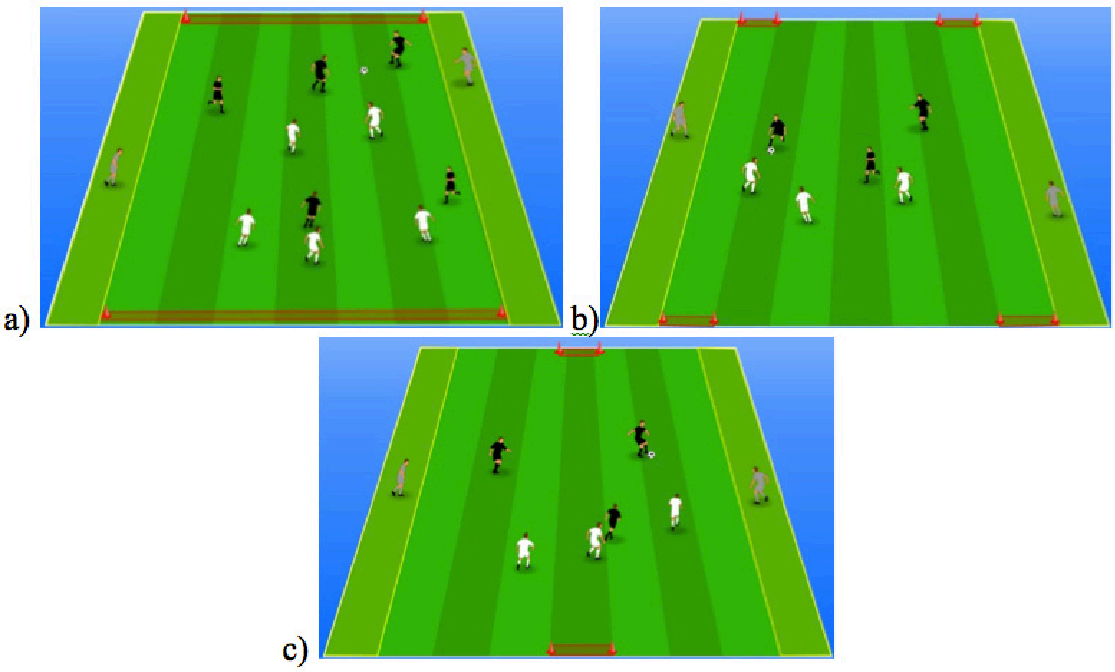

Figure 1. Task conditions: a) task 1; b) task 2; and c) task 3.

In the first task (T1), the main goal of game was to cross the opponent's endline and receive the ball from one teammate (Figure 1a). The neutral players provided coverage to the team with possession of the ball in a space on the sideline in all tasks. In the second task (T2), two reduced targets of two meters in length were placed beginning in the corners of field (Figure 1b). In both previous tasks (1 and 2), the way to score was similar to task 1 but only in the reduced targets. In the third task (T3), one central target of two meters in length was used, and the way to score was to cross the central endline with possession of the ball (Figure 1c). In fact, it was used to score a different way because, in a preliminary study, it was observed that scoring in a central goal using the passing method was very difficult. Thus, an adjustment on the method to score was performed. In the preliminary study, no differences between tasks were found in physiological responses and time-motion profiles in both kinds of player (field players and neutral players).

Assessment of the heart rate responses and time-motion profiles

The Yo-Yo intermittent recovery test was used in level 1 to estimate VO_2 max (Bangsbo, NØrregaard, & ThorsØ, 1991). This test consists of 20m runs repeated twice, which are back and forth between the starting, turning and finishing lines, and progressive increased speed is controlled by audio beeps from a tape recorder (Köklü, Asçi, Koçak, Alemdaroglu, & Dündar, 2011). The heart rate response was measured using the Polar RC3 GPS (Polar Electro, Finland) throughout the test. The maximum heart rate achieved by each player was determined by the mean of the higher three values. For the measure of resting heart rate, players (using the heart rate monitors) rested comfortably during the recording for at least 10 minutes in a supine position, and seven minutes in a standing position in a quiet, semi-dark room, with a temperature of (Gamelin, Berthoin, & Bosquet, 2006). From the heart rate data, the three lowest values and the mean value were collected.

To assess the heart rate responses during SSG, the heart rate monitors placed on players' chests were continuously used. The heart rate monitors recorded at 1-second intervals by a lightweight and portable heart rate monitor (Polar RC3 GPS with Heart Rate sensor, Finland). All heart rate data were downloaded and stored to a computer using the dedicated software (Polar WebSync and Polar Pro Trainer 5.0 software). The %HR reserve was computed using Karvonen's method (Janssen, 2001) to measure the players' responses. Using the Polar RC3 GPS speed (m/s) and acceleration (m/s^2) recorded at 1-second intervals were also estimated.

Statistical analyses

The influences of repetitions (three repetitions per SSG), game format and task factors on the HRmean, %HRreserve, speed and acceleration were analyzed using repeated measures two-way MANOVA after validating normality and homogeneity assumptions. After to found no differences between repeated measures, it was carried out the two-way MANOVA within each repetition that was specifically chosen because it reduces Type I error inflation compared with ANOVA (O'Donoghue, 2012, p. 242; Pallant, 2011, p.283). Moreover, in many cases, MANOVA can detect statistical differences that many one-way ANOVAs cannot (Maroco, 2011, p. 276; Pallant, 2011, p. 283). The assumption of normality for each univariate dependent variable was examined using Kolmogorov-Smirnov tests (*p-value* < .05). The assumption of the homogeneity of each group's variance/covariance matrix was examined with the Box's M Test. No homogeneity was shown. When the MANOVA detected significant statistical differences between the two factors, we proceeded to the two-way ANOVA for each dependent variable, followed by Tukey's HSD post-hoc test (O' Donoghue, 2012, p. 243). When the two-way ANOVA showed an interaction between factors, it also generated a new variable that crossed the two factors (e.g., 2v2*T1; 2v2*T2) for each dependent variable to identify statistical significance (Maroco, 2011). Ultimately, the statistical procedures used were one-way ANOVA and Tukey HSD post-hoc. If no interactions were detected in two-away ANOVA, a one-way ANOVA was used for each independent variable. All statistical analyses were performed using IBM SPSS Statistics (version 21) at a significance level of $p < .05$.

The classification of the effect size and the power of the test were done according to Hopkins, Hopkins and Glass (1996): very small: 0 - .01; small: .01 - .09; moderate: .09 - .25; large: .25 - .49; very large: .49 - .81; and nearly perfect: .81 - 1.0.

Results

Descriptive statistics of heart rate responses (Figure 2) and time-motion profiles during games performed in three task conditions were reported in Tables 1 and 2.

Repeated measures two-way MANOVA was carried out to analyze the variance between three repetitions (factor repetition) that were performed per each game. The repeated measured revealed that no differences were found between repetitions (*Pillai's Trace* = .075; $F_{8,\ 100}$ = 1.007; *p-value* = .436; = .075; *Power* = .445; small effect size). No differences were also found in the interactions repetitions*format (*Pillai's Trace* = 0.209; $F_{24,\ 306}$ = 0.956; *p-value* = .526; = .070; *Power* = .780; small effect size); repetions*task (*Pillai's Trace* = .169; $F_{16,\ 202}$ = 1.007; *p-value* = .299; = .084; *Power* = .749; small effect size); and repetions*format*task (*Pillai's Trace* = 0.337; $F_{48,\ 630}$ = .780; *p-value* = .858; = .056; *Power* = .890; small effect size). Considering that no differences were found between the repetitions per SSG (no differences in repeated measures), the next step was carried out the differences per game in an isolate fashion.

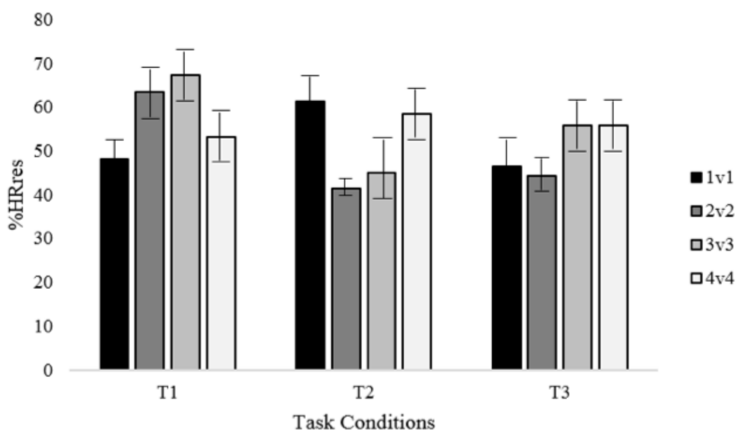

Figure 2. Values of mean (and SD) of heart rate responses (%HRres) for SSG formats and task conditions. T1: cross the opponent's endline and receive the ball from one teammate; T2: cross the opponent's targets and receive the ball from one teammate; T3: the way to score was to cross the central endline with possession of the ball.

For the repetition 1 (game 1): Two-way MANOVA results revealed that the format had significant main effects (*Pillai's Trace* = 0.322; $F_{12,318}$ = 3.187; *p-value* = .001; = .107; *Power* = .995; moderate effect size) on heart rate responses and time-motion profiles. The task conditions had a significant main effects (*Pillai's Trace* = 0.307; $F_{8,210}$ = 4.762; *p-value* = .001; = .154; *Power* = .998; moderate effect size) on heart rate responses and time-motion profiles. Finally, significant interaction effects between the two factors on heart rate responses and time-motion profiles were observed (*Pillai's Trace* = 0.699; $F_{24,428}$ = 3.774; *p-value* = .001; = .175; *Power* = 1.000; moderate effect size). As previously indicated in the statistical procedures, a two-way ANOVA was conducted for each dependent variable after the confirmation of the interaction (O'Donoghue, 2012, p. 243).

Interaction was found between factors for HRmean ($F_{6,107}$ = 8.701; *p* = .001; = .328; *Power* = 1.00; large effect size), %HRreserve ($F_{6,107}$ = 8.996; *p* = .001; = .335; *Power* = 1.00; large effect size), speed ($F_{6,107}$ = 6.108; *p* = .001; = .255; *Power* = .998; large effect size), and acceleration ($F_{6,107}$ = 1.085; *p* = .376; = .057; *Power* = .412; small effect size).

The one-way ANOVA tested the crossing between factors. Statistical differences were found between the new variable (cross between format and task) and the dependent variables of HRmean ($F_{11,107}$ = 7.318; *p* = .001; = .429; *Power* = 1.00; large effect size), %HRreserve ($F_{11,107}$ = 7.367; *p* = .001; = .431; *Power* = 1.00; large effect size), and speed ($F_{11,107}$ = 6.768; *p* = .001; = 0.410; *Power* = 1.00; large effect size). The *post-hoc* results observed are shown in Table 2.

In the case of acceleration, a one-way ANOVA was performed on each independent variable because no interaction was found between factors. The results for acceleration showed no statistical difference in tasks in the 1v1+2 ($F_{2,27}$ = 1.993; *p* = .157; = .133; *Power* = 0.374; moderate effect size), 2v2+2 ($F_{2,27}$ = .815; *p* = .453; = .057; *Power* = .175; small effect size), 3v3+2 ($F_{2,27}$ = .572; *p* = .571; = .041; *Power* = .135; small effect size), and 4v4+2 ($F_{2,27}$ = 2.520; *p* = .099; = .157; *Power* = .461; moderate effect size) formats.

In the case of acceleration, a one-way ANOVA was performed on each independent variable because no interaction was found between factors. The results for acceleration showed no statistical difference in tasks in the T1 ($F_{3,36}$ = 0.304; *p* = .822; = .025; *Power* = 0.103; small effect size), T2 ($F_{3,36}$ = 3.036; *p* = .793; = .062; *Power* = .203; small effect size), and T3 ($F_{3,36}$ = 1.657; *p* = .194; = .121; *Power* = 0.397; small effect size).

Table 2. Descriptive table (mean and standard deviation) and statistical comparison between crossing factors (game 1).

	1v1+2			2v2+2			3v3+2			4v4+2		
	Task 1	Task 2	Task 3	Task 1	Task 2	Task 3	Task 1	Task 2	Task 3	Task 1	Task 2	Task 3
HRmean	128.98 (6.87)[g]	141.49 (9.24)[e,h]	125.24 (14.35)[g]	142.37 (8.43)[e,f,h]	119.28 (5.69)[g,i,k]	122.15 (17.71)[g,k]	150.78 (9.72)[h,l]	119.91 (16.81)[k]	137.51 (11.10)	135.54 (12.91)	141.35 (17.24)	132.01 (12.11)
%HRres	50.16 (5.39)[g]	60.59 (8.08)[e,f,h]	47.24 (11.22)[d,g]	63.46 (6.69)[h]	41.47 (3.57)[g,i,k]	44.94 (6.73)[g]	67.74 (8.75)[h]	42.44 (15.10)[i,k]	57.75 (9.35)	55.03 (11.93)	57.89 (13.76)	54.68 (10.22)
Speed (m/s)	0.34 (0.24)[b,g,i,j,k,l]	1.21 (0.52)[c,f]	0.43 (0.37)[g,i,j,k,l]	0.93 (0.30)	0.82 (0.32)	0.59 (0.39)[j,l]	1.08 (0.21)	0.74 (0.33)[j]	1.05 (0.28)	1.33 (0.63)	1.13 (0.24)	1.21 (0.52)

Significantly different compared with 1v1+2*T1[a]; 1v1*T2[b]; 1v1*T3[c]; 2v2*T1[d]; 2v2*T2[e]; 2v2*T3[f]; 3v3*T1[g]; 3v3*T2[h]; 3v3*T3[i]; 4v4*T1[j]*; 4v4*T2[k]; 4v4*T3[l] at $p <$ .05. In the table it was only identified one difference A-B, because the opposite B-A is also symmetrically different (thus, is the same *p-value*).

Table 3. Descriptive table (mean and standard deviation) and statistical comparison between crossing factors (game 2).

	1v1+2			2v2+2			3v3+2			4v4+2		
	Task 1	Task 2	Task 3	Task 1	Task 2	Task 3	Task 1	Task 2	Task 3	Task 1	Task 2	Task 3
HRmean	128.58 (11.05)[g]	140.64 (6.58)[c,e,f,h]	120.70 (10.52)[d,g,k]	142.28 (12.34)[e,f,h]	119.21 (5.27)[g,k]	120.79 (10.73)[g,k]	149.57 (14.29)[h]	123.52 (11.57)[k]	135.13 (11.40)	132.93 (12.33)	141.98 (14.79)	133.26 (11.46)
%HRres	49.79 (7.67)[g]	59.98 (6.20)[c,e,f,h]	43.62 (7.14)[d,g,k]	63.23 (9.60)[e,f,h]	41.03 (2.89) g,i,k,l	44.21 (7.06)[g,k]	66.01 (13.18)[h]	45.82 (10.72)	55.88 (9.51)	52.62 (11.39)	58.25 (11.74)	55.78 (9.66)
Speed (m/s)	0.57 (0.50)b,j	1.28 (0.51) c,f	0.26 (0.25) d,g,h,i,j,k,l	0.96 (0.36)	0.80 (0.27)	0.55 (0.27)[j]	1.10 (0.42)	0.92 (0.21)	0.94 (0.42)	1.23 (0.65)	1.05 (0.42)	1.03 (0.38)

Significantly different compared with 1v1+2*T1[a]; 1v1*T2[b]; 1v1*T3[c]; 2v2*T1[d]; 2v2*T2[e]; 2v2*T3[f]; 3v3*T1[g]; 3v3*T2[h]; 3v3*T3[i]; 4v4*T1[j]*; 4v4*T2[k]; 4v4*T3[l] at $p <$ .05. In the table it was only identified one difference A-B, because the opposite B-A is also symmetrically different (thus, is the same *p-value*).

For the repetition 2 (game 2): Two-way MANOVA results revealed that the format had significant main effects (*Pillai's Trace* = .272; $F_{12,318}$ = 2.647; *p-value* = .002; = .091; *Power* = .980; small effect size) on heart rate responses and time-motion profiles. The task conditions had a significant main effects (*Pillai's Trace* = .348; $F_{8,210}$ = 5.534; *p-value* = .001; = .174; *Power* = .999; moderate effect size) on heart rate responses and time-motion profiles. Finally, significant interaction effects between the two factors on heart rate responses and time-motion profiles were observed (*Pillai's Trace* = .712; $F_{24,428}$ = 3.860; *p-value* = .001; = .178; *Power* = 1.000; moderate effect size). As previously indicated in the statistical procedures, a two-way ANOVA was conducted for each dependent variable after the confirmation of the interaction (O'Donoghue, 2012, p. 243).

Interaction was found between factors for HRmean ($F_{6,107}$ = 8.802; p = .001; = .330; *Power* = 1.00; large effect size), %HRreserve ($F_{6,107}$ = 9.464; p = .001; = .347; *Power* = 1.00; large effect size), speed ($F_{6,107}$ = 4.399; p = .001; = .198; *Power* = .979; moderate effect size), and acceleration ($F_{6,107}$ = 1.569; p = .163; = .081; *Power* = .583; small effect size).

The one-way ANOVA tested the crossing between factors. Statistical differences were found between the new variable (cross between format and task) and the dependent variables of HRmean ($F_{11,107}$ = 7.770; p = .001; = .444; *Power* = 1.00; large effect size), %HRreserve ($F_{11,107}$ = 7.705; p = .001; = .442; *Power* = 1.00; large effect size), and speed ($F_{11,107}$ = 5.379; p = .001; = .356; *Power* = 1.00; large effect size). The *post-hoc* results observed are shown in Table 3.

In the case of acceleration, a one-way ANOVA was performed on each independent variable because no interaction was found between factors. The results for acceleration showed no statistical difference in tasks in the 1v1+2 ($F_{2,27}$ = 2.573; p = .096; = .165; *Power* = .468; moderate effect size), 2v2+2 ($F_{2,27}$ = .237; p = .791; = .017; *Power* = .083; small effect size), 3v3+2 ($F_{2,27}$ = 2.869; p = .074; = .175; *Power* = .515; moderate effect size), and 4v4+2 ($F_{2,27}$ = .247; p = .783; = .018; *Power* = .085; small effect size) formats.

In the case of acceleration, a one-way ANOVA was performed on each independent variable because no interaction was found between factors. The results for acceleration showed no statistical difference in tasks in the T1 ($F_{3,36}$ = .756; p = .527; = .061; *Power* = .195; small effect size), T2 ($F_{3,36}$ = 2.350; p = .089; = .164; *Power* = .542; moderate effect size), and T3 ($F_{3,36}$ = 1.064; p = .377; = .081; *Power* = .264; small effect size).

For the repetition 3 (game 3): Two-way MANOVA results revealed that the format had significant main effects (*Pillai's Trace* = .458; $F_{12,318}$ = 4.773; *p-value* = .001; = .153; *Power* = 1.000; moderate effect size) on heart rate responses and time-motion profiles. The task conditions had a significant main effects (*Pillai's Trace* = .291; $F_{8,210}$ = 4.473; *p-value* = .001; = .146; *Power* = .996; moderate effect size) on heart rate responses and time-motion profiles. Finally, significant interaction effects between the two factors on heart rate responses and time-motion profiles were observed (*Pillai's Trace* = .729; $F_{24,428}$ = 3.972; *p-value* = .001; = .182; *Power* = 1.000; moderate effect size). As previously indicated in the statistical procedures, a two-way ANOVA was conducted for each dependent variable after the confirmation of the interaction (O'Donoghue, 2012, p. 243).

Interaction was found between factors for HRmean ($F_{6,107}$ = 11.263; p = .001; = .387; *Power* = 1.00; large effect size), %HRreserve ($F_{6,107}$ = 12.002; p = .001; = .402; *Power* = 1.00; large effect size), speed ($F_{6,107}$ = 2.201; p = .048; = .110; *Power* = .800; moderate effect size), and acceleration ($F_{6,107}$ = 1.903; p = .087; = .096; *Power* = .683; moderate effect size).

The one-way ANOVA tested the crossing between factors. Statistical differences were found between the new variable (cross between format and task) and the dependent variables of HRmean ($F_{11,107}$ = 8.556; p = .001; = .468; *Power* = 1.00; large effect size), %HRreserve ($F_{11,107}$ = 8.532; p = .001; = .467; *Power* = 1.00; large effect size), and speed ($F_{11,107}$ = 4.539; p = .001; = .318; *Power* = .999; large effect size). The *post-hoc* results observed are shown in Table 4.

In the case of acceleration, a one-way ANOVA was performed on each independent variable because no interaction was found between factors. The results for acceleration showed no statistical difference in tasks in the 2v2+2 ($F_{2,27}$ = 1.825; p = .181; = .119; *Power* = .347; moderate effect size), 3v3+2 ($F_{2,27}$ = 1.793; p = .186; = .117; *Power* = .341; moderate effect size), and 4v4+2 ($F_{2,27}$ = .868; p = .431; = .060; *Power* = .183; small effect size) formats. It was found statistical differences in 1v1+2 ($F_{2,27}$ = 4.180; p = .027; = .243; *Power* = .812; moderate effect size), more specifically between task 2 and (p = .022) with greatest values in the task 2.

In the case of acceleration, a one-way ANOVA was performed on each independent variable because no interaction was found between factors. The results for acceleration showed no statistical difference in tasks in the T2 ($F_{3,36}$ = 2.167; p = .109; = .153; *Power* = .506; moderate effect size), and T3 ($F_{3,36}$ =

Table 4. Descriptive table (mean and standard deviation) and statistical comparison between crossing factors (game 3).

	1v1+2			2v2+2			3v3+2			4v4+2		
	Task 1	Task 2	Task 3	Task 1	Task 2	Task 3	Task 1	Task 2	Task 3	Task 1	Task 2	Task 3
HRmean	125.20 (8.88)[b,g,k]	146.12 (7.62)[c,e,f,h]	127.24 (15.29)[g]	141.85 (13.83)[e,f,h]	120.90 (5.75)[g,k]	121.43 (9.70)[g,k]	151.97 (10.75)[h,i,j,l]	123.40 (8.91)[k]	135.13 (10.05)	134.18 (12.27)	143.43 (15.16)	132.76 (11.54)
%HRres	47.03 (6.39)[b,d,g]	64.74 (6.32)[c,e,f,h]	49.34 (12.01)[g]	62.89 (10.98)[e,f,h]	42.26 (2.94)[g,k]	44.90 (5.81)[g,k]	68.11 (9.53)[h,j]	45.72 (9.01)[k]	55.88 (8.28)	53.77 (11.34)	59.48 (12.02)	55.34 (9.72)
Speed (m/s)	0.38 (0.16) [b,d,g,j,k,l]	1.03 (0.43)c	0.36 (0.34) [d,e,g,j,k,l]	1.04 (0.25)	1.01 (0.40)	0.79 (0.66)	1.02 (0.25)	0.93 (0.42)	0.89 (0.32)	1.22 (0.58)	1.17 (0.46)	1.12 (0.35)

Significantly different compared with 1v1+2*T1[a]; 1v1*T2[b]; 1v1*T3[c]; 2v2*T1[d]; 2v2*T2[e]; 2v2*T3[f]; 3v3*T1[g]; 3v3*T2[h]; 3v3*T3[i]; 4v4*T1[j]*; 4v4*T2[k]; 4v4*T3[l] at $p < .05$. In the table it was only identified one difference A-B, because the opposite B-A is also symmetrically different (thus, is the same *p-value*).

2.533; $p = .072$; = .174; *Power* = .577; moderate effect size). It was found statistical differences in T1 ($F_{3,36} = 3.319$; $p = .031$; = .222; *Power* = 0.801; moderate effect size), more specifically between format 2v2+2 and 4v4+2 (p = .032) with greatest values in the format 4v4+2.

Discussion

The aim of this study was to inspect the neutral players' performance responses during different SSG. Four formats of play and three task conditions were used using neutral players' responses throughout the games. We identify that the highest heart rate responses were found mostly in the biggest format (*4v4+2)*, and in task conditions with no goals but with endlines. Moreover, it was also found that the highest time-motion values were achieved in the biggest format (*4v4+2*) and in task conditions with two targets.

The highest mean values of HRmean (136.96 bpm) and HRres (56.36%) were found in the biggest format of game (*4v4+2*). Closer values were found in *3v3+2* (136.32 HRmean; 56.16%HRres). The lowest values were found in *2v2+2* (127.72 HRmean; 49.76%HRres) followed by *1v1+2* (131.02 HRmean; 52.24%HRres). Generally, the heart rate responses of players during SSG are greater in smaller formats (Hill-Haas *et al*., 2009; Dellal *et al*., 2011; Köklü, 2012). In the case of neutral players, such tendency seems to be the contrary. The biggest the game formats are the greater the heart rate responses is expected to be. We assume that this is due to the technical/tactical complexity of bigger formats. In games with greater number of opponents, the defensive will be more intense and likely increase the number of interceptions (Owen, Wong, Paul, & Dellal, Physical and Technical Comparisons between Various-Sided Games within Professional Soccer, in press). Therefore, the importance of neutral players may increase due to the opportunity to play in a safe zone (in the case of these specific games). Thus, the increasing of neutral players' recruitment also increased their heart rate responses. Nevertheless, such a possibility is only theoretical. In that sense, such evidence must be analyzed in future works by matching physiological responses and time-motion profiles with technical and tactical analysis.

Nevertheless, it is important to consider the profile of neutral players' heart rate responses throughout the game formats. The mean values of heart rate responses ranged between 49.76% and 56.36% of HRres. Such values indicate a very light rate typically observed after the recovery workout (Janssen, 2001). Therefore, the use of neutral players in outside zones of the field can be appropriated to ensure a great dynamic during a training session. Instead of passively recover between repetitions (games), the players can exchange positions as player and neutral player. Such routine allows them endure the training session and simultaneously ensures a recovery period for the intermittent characteristics of the training workout.

In the case of different task conditions, the highest heart rate intensities were found in tasks with no targets but with endlines (137.70 HRmean; 57.51%HRres), and the lowest rates were achieved in tasks with one target (128.53HRmean; 50.84%HRres). The possibility to explore all endlines may increase the recruitment of neutral players to reduce the effect from a defensive pressing inside the field. Therefore, the greater activity of neutral players results in an increased heart rate response. Nevertheless, it is possible to observe that the range of heart stimulation of neutral players is consistent with very light effort or after recovery workouts (Janssen, 2001).

The time-motion characteristics investigated in this study suggest that the highest mean values of distance coverage, speed and acceleration were performed in the *4v4+2* format, and the lowest in smaller formats (*1v1+2* and *2v2+2*). Once again, the greater requirement of neutral players in format with more opponents may be the reason to justify such results. As for task conditions, the highest values of time-motion variables were observed during the task 2 (with two targets). The specific case of using two displaced targets may increase the tendency to explore the neutral players' in depth and length mobility. Such tactical behavior is used in order to try to disrupt the opponent's defensive organization, displacing the teammates. Therefore, quick actions also increase the speed of movements and acceleration as well.

Practical applications

In this study, we observed that the opportunity to use neutral players can reduce the periods of non-activity in training sessions. Values between 50% and 56% of HRres in neutral players throughout 12 games were found. Such games involved different formats of play but only using neutral players. The heart rate responses collected from these games suggested that being a neutral player is consistent with exertion demands observed during a very light or recovery workout. In that sense, the training session can be highly dynamic if the use of neutral players alternates between activities of high-intensity. Therefore, the intermittent training programs used in high-intensity workouts can be performed without pauses (if desired by a coach). For example, for a work/recovery ratio of 1:1, it is possible to alternate the position of being a player in *1v1+2* during 1'30'' and immediately exchange with external neutral players for another round of practice. Thus, without pauses, it is possible to ensure a ratio of high-intensity workout to an active recovery workout being a neutral player. Such findings can be important to optimize the workout time and to ensure an effective dynamic in the training process.

Therefore, the use of neutral players is not only rich in a physiological workout point-a-view. In fact, the use of neutral players is quite valuable as a didactical content; thus, more than just fitness, the use of neutral players can help coaches introduce tactical contents and change the technical actions during the SSG. In the specific case of this study, no results were collected about tactical behavior. However, it is possible to assume that the use of neutral players, mainly in larger fields, can help the players within the game to consolidate the width and length principle of play using the sides of the field to exploit the opponents' tactical organization. Moreover, the neutral player will understand the kind of movements that must be performed to create lines of passes for their teammates and support them in the moments during the possession of the ball. In sum, the use of neutral players can be understood as a small-sided and conditioned game that uses the pedagogical principle of exaggeration to augment the perception of players to learn a given principle of play.

Conclusion

The aim of this study was to inspect the effects of being a neutral player in different small-sided games on heart rate responses and time-motion characteristics. Four formats of play using neutral players and three task conditions were inspected. It was found that highest heart rate responses were achieved in the biggest format (*4v4+2*) in the task condition with no goals but with endlines. Furthermore, the highest time-motion characteristics were achieved in the biggest format (*4v4+2*) and in the task condition with two targets. The major findings were the unique mean values of heart rate responses during those games. In other words, heart rate values were compatible with exertion during a very light or recovery workout. Moreover, this kind of task constraint is also important to tactical learning, augmenting the players' perception for a given tactical principle.

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